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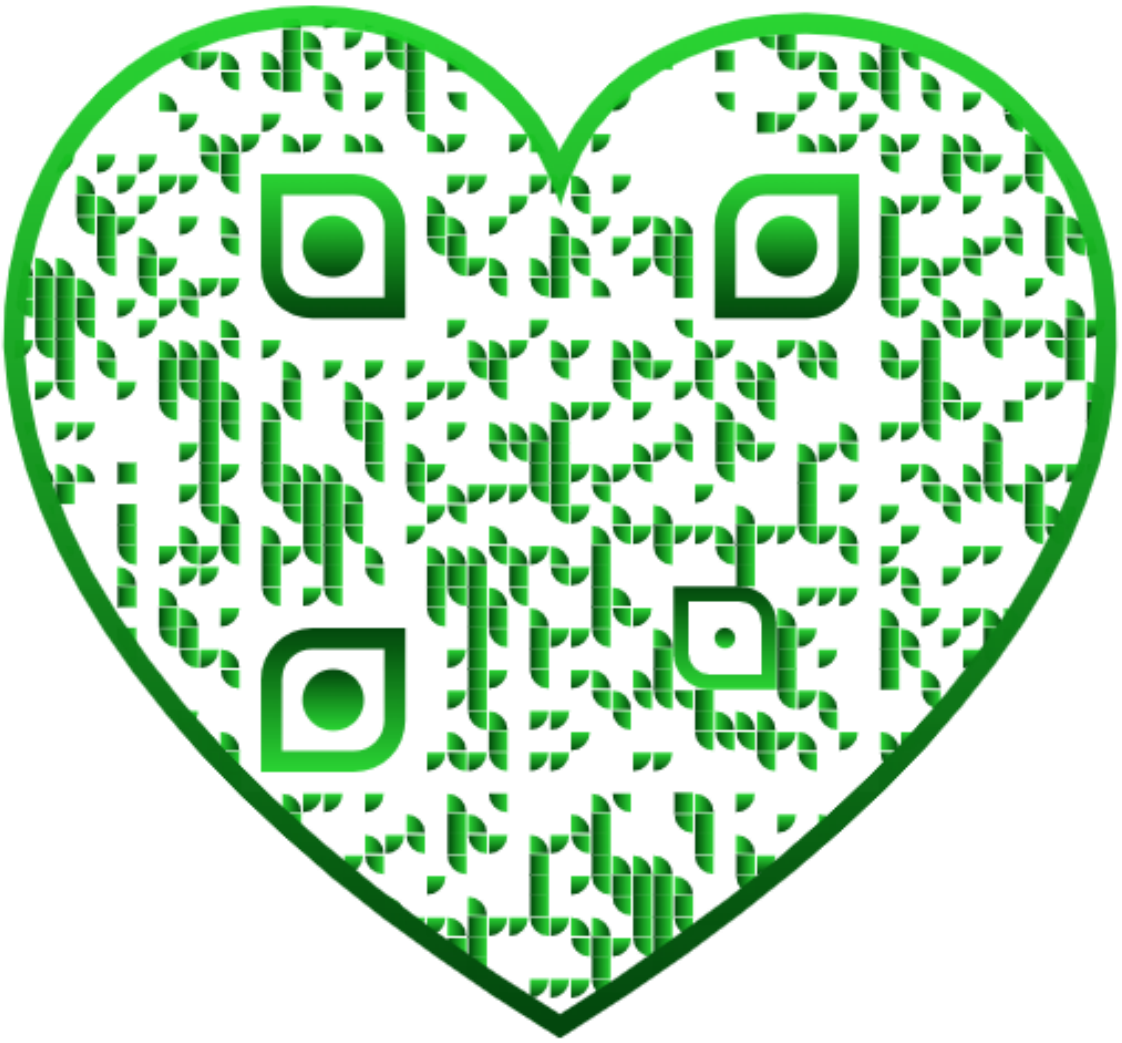
# SCIENCE RELIGION AND THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE

DAVID WILKINSON



# *Science, Religion, and the Search for Extraterrestrial Intelligence*

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# Foreword

Nearly twenty years ago, when I was in my 'Christian period', I wrote to *The Times* suggesting the formation of a 'Canterbury Academy of Sciences' which would grapple with some of the great problems of science and endeavour to advise the clergy, and others, on what Christian attitudes might be. The idea fell on stony ground, but the need remains. One of the problems listed was the possibility of extraterrestrial intelligence (ETI) and what the impact of its discovery on religion might be. Now, in my (temporary?) 'post-Christian period', the need still exists, but an eminent 'scientific theologian', the Rev. Professor David Wilkinson, has seized the nettle and given us his considered views.

David has considered virtually all aspects of the problem: historical views, the likelihood of success in the present search, attitudes to the religious dimension, and so on. Part of this dimension is a case of 'be prepared'; that is, what to say to the flock if a positive detection is announced. Forewarned is forearmed.

The Church is lucky to have someone of David Wilkinson's wide knowledge of both science and theology, and soundly based judgement to act as a guide.

A personal experience of some years ago has relevance, and shows the multifaceted nature of the subject. After a lecture of mine on 'The Search for Intelligent Life', which included a description of our eventual need to leave the Earth when the Sun runs out of fuel, a member of the audience became emotional. He said: 'I am incredibly heartened to know that when our successor Christians leave the Earth they will act as missionaries to spread The Word beyond the confines of our planet.' The reason for mentioning this is that it is one of many unexpected aspects of ETI, and one that is relevant to any religion, not just Christianity.

In this book the author gives us a fine explanation of where we have reached in the ETI search, as well as his views on the religious aspects of 'life in space'. This is both a scholarly work, with copious references, and a very readable one. For atheists and believers alike, there is much food for thought.

Professor Sir Arnold Wolfendale, FRS, 14th Astronomer Royal

# Acknowledgements

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The staff at OUP have been a delight to work with and I am grateful to my colleagues and students at St John's College for the gift of study leave during which this book was written.

In all that I do I am constantly and generously supported by Alison, Adam and Hannah to whom this book is dedicated.

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# Contents

**Introduction** **1**

**1 Cinema, Cults, and Meteorites: Searching for Something More** **6**
1.1 Science and Fiction? Universes Full of Aliens 6
1.2 Science and the Media: Understanding the Universe from a Piece of Rock 9
1.3 Science and Religion: The New Mythology of a Place among Aliens 13

**2 Speculating about a Plurality of Worlds: The Historical Context of Science, Religion, and SETI** **16**
2.1 Atomism and Plenitude 16
2.2 The Infinite Power of God and the Centrality of Man 18
2.3 Deism and Evolution 25

**3 Hubble and Drake: SETI and Cosmology** **29**
3.1 The Universe is Big, Really Big 30
3.2 The Goldilocks Enigma 34
3.3 Drake's Equation: Agenda or Calculation? 39
3.4 ET's Long-Distance Phone Call Home 41

**4 The Daily Planet** **45**
4.1 Finding another Earth? 45
4.2 Wobbling Stars 48
4.3 Dimming Stars 51
4.4 Brightening Stars 53
4.5 Young Planets and Hot Planets 54
4.6 A Planet that is Just Right 54
4.7 Delays and Cuts: Future Prospects and Problems 60

**5 Genesis 2.0? SETI and Biology 62**
5.1 The Origins of Life 63
5.2 The Evolution of Aliens 67
5.3 The Inevitability of Life? 69
5.4 Intelligence and Consciousness 76
5.5 Life, but Not as We Know It 79

**6 Looking for a Needle in a Haystack: Current SETI Strategies 83**
6.1 Searching for Interstellar Communication 83
6.2 Discovering and Understanding Little Green Men 85
6.3 SETI Programmes: Bagging Little Green Fellows 89
6.4 First Contact 92

**7 Fermi's Paradox 98**
7.1 Where is Everybody? 98
7.2 They Exist but They are Not Here or Have Not Called 101
7.2.1 ET, stay home 101
7.2.2 The zoo hypothesis 102
7.2.3 Aliens as gods 105
7.2.4 The Doomsday argument 107
7.3 Visited Planet? 109
7.4 If They Existed They Would be Here: A Tentative Conclusion? 114

**8 The 'Myths' of SETI and Religion 116**
8.1 Evidence for Cosmic Design? 116
8.2 God is an Alien 119
8.3 Contact Problems for Religion 125

**9 SETI and the Christian Understanding of Creation 130**
9.1 A New View of God as Creator? 130
9.1.1 God is sovereign in the creation of the Universe 132
9.1.2 God is the source and sustainer of the universal laws 134
9.1.3 God is an extravagant creator 135
9.2 A New View of What it Means to be Human? 138
9.2.1 Human beings in the context of worship 140
9.2.2 Human beings in the image of God 142

**10 SETI and the Christian Understanding of Redemption 150**
10.1 The Cosmic Significance of Jesus 153
10.2 Do Aliens Sin? 159
10.3 The Cross—Once for All? 163
10.4 New Creation 169

**11 Be Not so Positive 172**
11.1 The Religious Motivation of SETI 173
11.2 The Value of SETI to Christian Theology 178
11.3 The Value of Christian Theology to SETI 180

**Bibliography 185**
**Index of Biblical Passages 213**
**Index 214**

# Introduction

After its seven minutes of terror in negotiating the atmosphere, NASA landed its robotic rover Curiosity on the surface of Mars in August 2012. Its primary goal was to investigate whether conditions have ever been favourable for microbial life and for preserving clues in the rocks about possible past life. It was a small part in addressing the big question of whether we are alone in the Universe.

Curiosity carries equipment to gather and analyse samples of rocks and soil, but it also carries on it the signature of Clara Ma, a high-school student from Kansas. Clara was the 12-year-old winning entrant in a national naming contest for the rover. She wrote: 'Curiosity is the passion that drives us through our everyday lives. We have become explorers and scientists with our need to ask questions and to wonder' (Ma, 2009).

While Dorothy Parker characteristically said that 'Love, curiosity, freckles, and doubt' were the four things she had been better without, curiosity is at the heart of the scientific enterprise and indeed part of what it means to be human.

The search for extraterrestrial intelligence (SETI) is now entering its most important era of scientific development. New observing techniques are leading to the daily discovery of extrasolar planets, and the Kepler mission has already collected more than 1,000 planetary candidates. From the discovery in 1995 of the first planet around a star similar to our Sun, this deluge of data is transforming the scientific and popular view of the existence of extraterrestrial intelligence. Earth-like planets outside our solar system can now be identified and in future years explored for signs of life.

The Astronomer Royal, Lord Martin Rees, calls this our 'greatest quest' (Rees, 2003b: 25), and others have said that the discovery of any form of extraterrestrial intelligence (ETI) would be 'one of the greatest events in the history of humankind' (Almar and Race, 2011). This is certainly borne

out by the public interest in such a subject. From the inevitable question at the end of any public talk on astronomy, through the popularity of science fiction, to the more than 3 million people who have used their home computer to download and analyse some of the SETI Institute's data-stream from radio telescopes, very few areas of science spark the imagination and feed fascination as does this one.

Perhaps at its very core is the question of what it means to be human. If the human species is just one intelligence among many in the Universe, then some think that our cosmic status is somewhat different to our being the unique seed of consciousness. A constant question is asked of big science, whether it be the Large Hadron Collider or space telescopes, which is: what does this mean for us? In this context a positive result for SETI seems to be at least as important as the nature of the Higgs particle or the history of the Big Bang.

Yet in the light of this it is odd that SETI as a scientific discipline has found it difficult to secure public funding. Many of the SETI searches continue to be supported by private benefactors. This is no doubt a reflection of how difficult the task is, and the lack of confidence in early or definitive results. Yet there may be other significant factors, such as the complexity of interpretation of what a positive result might be and what it might mean. There are a number of voices who seem to describe a scenario where the message from humanoid aliens reaches us already translated into English, leading to the rapid advancement of our society and the closing down of religion. But the whole question is much more complicated and indeed much more exciting for science and religion.

It is now more than 50 years since the publication of the first scientific papers which began the modern era of SETI. While there is a long intellectual tradition predating this in considering the implications of other possible worlds, religious thinkers, with a few and notable exceptions, have been relatively silent in the last few decades on this subject. It is certainly the case that mainstream Christian theology has not engaged at depth, leaving much religious speculation to the writers of popular science (Davies, 2011a). Current scientific advances in SETI are now showing the danger of such an absence of theological engagement. Faith communities still working through relationships between Big Bang and the creation narratives, natural selection and God's purpose, neuroscience, and what it means to be human, could be hit by a tidal wave of questions following indications of success in SETI.

This book arises out of a conviction that the issues that SETI raises, whether it is successful in the short-term, long-term, or not at all, are

fruitful rather than destructive for religious belief. This is therefore not the construction of defences against a tidal wave of questions, but an attempt to understand the lie of the land identifying both challenges and opportunities. In order to do this we need to set out the scientific arguments undergirding SETI, with particular attention to the history, the uncertainties in arguments, and the strength of the data already assembled. It is important to do this carefully rather than to rush too quickly to the religious implications. Faith communities do themselves great disservice by not taking time to understand the science involved. Even before that we need to recognize that science does not stand apart from a culture in which it exists. Media images, religious sensitivities, and contemporary narratives all have a subtle part to play in shaping science, challenging it, and using its discoveries. Perhaps nowhere has this been more of the case than in the dialogue between science and science fiction in speculation about SETI. We will therefore need to review the current cultural and past historical situations as they impact on SETI. Only having done all of this, we will then move on to consider the way that scientists working in the area have used SETI in either supporting or attacking religion. It is fascinating to see that the arena of SETI has been filled with many of the conversations of science and religion which we have seen in other contexts. We will encounter again the classic arguments for the existence of God, the nature of the Christian Scriptures, and the basis for religious belief. The final section gives an initial theological response, and argues that part of the motivation for SETI has religious resonances.

Many historians of science point to the influence of the Christian faith in the development of the kind of curiosity upon which science is based. The Greeks had developed science employing human logic to understand the world. However, astronomers such as Galileo and Kepler realized that if the Universe had been created freely by God, not bound by human logic, then it was necessary to first and foremost look at the Universe in order to find out what it was all about. This theological emphasis on observation became the basis for the empirical science we practice today, believing that it is worth even $2.5 billion to put a rover on the surface of Mars.

The broadcaster Alistair Cooke once said: ‘Curiosity endows the people who have it with a generosity in argument and a serenity in their own mode of life which springs from their cheerful willingness to let life take the form it will.’ This form of curiosity seems to me to be important for science, faith, and life itself. This book will argue that theologians need to take seriously SETI and to examine some central doctrines of religious

belief in the light of the possibility of extraterrestrial life, hopefully with a spirit of such curiosity.

Any Christian theologian pursuing this kind of enquiry is reminded of the often quoted case of Giordano Bruno, who in 1600 was burnt at the stake at the hands of the Inquisition for exploring issues such as SETI. In fact, he was found guilty of multiple charges of which an infinite Universe and a plurality of other worlds were simply a small part (Rowland, 2008). Nevertheless, if that is not enough to indicate that one should proceed with caution, then one can also be reminded of the words of Thomas Paine in *The Age of Reason*. Commenting on Christianity and the existence of other worlds, he claimed that he who thinks he believes in both has 'thought but little of either'!

Of course, at the very beginning one must acknowledge the difficulty of the task and my own limitations in addressing the question. If the science is complex and in places controversial, religion itself is a diverse phenomenon existing in different cultural forms with a wide diversity in theological understanding. I therefore need to limit this question to the tradition I know best, which is Christianity. This is not to devalue other religious traditions or to say that Christianity is the easiest to fit with SETI; it is simply a practical matter of what is possible, and perhaps a small encouragement to thinkers from other faith communities to do similar pieces of work.

I write this here in Durham University. Only a few miles away, in the eighteenth century, the astronomer Thomas Wright stated in his *The Use of Globes*, 'stars are so many suns, that each of these stars or suns is attended, (as ours is) by a proper number of planets and comets; and that each hath a gravitating power independent of each other . . . (so that) these several systems cannot interfere with each other' (Wright, 1740). Then, in his *An Original Theory or New Hypothesis of the Universe* (1750), he used a plurality of worlds to give hope:

> *In this great Celestial Creation, the Catastrophy of a World, such as ours, or even the total Dissolution of a System of Worlds, may possibly be no more to the great Author of Nature, than the most common Accident in Life with us, and in all Probability such final and general DoomsDays may be as frequent there, as even Birth-Days or Mortality with us upon this Earth. (Wright, 1750)*

Among the manuscripts in Durham University Library there is a sequel to this later volume, in which he expresses the belief that the sky is solid and studded with inward-pointing volcanoes down whose shafts we see the stars. Eccentric and bizarre—but as Hoskin and Rochester conclude, Wright

was attempting to articulate a cosmology in which the divine, moral, and scientific universes were integrated (Hoskin and Rochester, 1992).

This book may be seen by some of my colleagues in science and theology as equally eccentric and bizarre. But I am convinced that even if integrating the divine and scientific universes is a step too far, the two need to be brought into dialogue.

# 1
# Cinema, Cults, and Meteorites: Searching for Something More

Scientific curiosity does not exist in a vacuum. Science is done by men and women who want to ask questions about the Universe, but also need to look for and justify funding both within and outside the scientific community. Priorities in science vary over time, building on what has already been discovered, what technology now makes possible, and indeed political agendas. In the 50th anniversary year of the publication of Thomas Kuhn's *The Structure of Scientific Revolutions,* it is worth being reminded of the way that science navigates its way through the turbulent waters of power structures and beliefs (Kuhn, 1962).

As Alan Boss's brilliant history of the recent programmes of searches for extrasolar planets makes clear, science is both exhilarating and frustrating as it attempts to navigate these choppy waters of internal scientific disagreements and external changing circumstances (Boss, 2009). SETI in particular has been susceptible to such conditions; yet it has additional currents to deal with, not always shared by other scientific questions. These are the worlds of science fiction, intense media interest, and religion.

## 1.1 Science and Fiction? Universes Full of Aliens

A number of years ago the cosmologist Lawrence Krauss wrote an entertaining book on the physics of *Star Trek* (Krauss, 1997). He justified this diversion from his usual scientific output with the observation that the number of people who did not recognize 'Beam me up Scotty' was comparable to the number of people who had never heard of ketchup. More importantly, he suggested that '*Star Trek* is a natural vehicle for many people's curiosity about the Universe.' (Krauss, 1997: xvi) In his foreword to the book, Stephen Hawking echoed this, saying, 'Science fiction like *Star Trek* is not only good fun but it also serves a serious purpose, that of expanding the human imagination.' (Krauss, 1997: xi)

To judge by the consumption of science fiction in television, novels, films, and video games, the public feed very readily on expanding the human imagination. Science and science fiction exist symbiotically in this. One of the central aspects of the relationship has been the existence and nature of extraterrestrials. Science fiction films depicting extraterrestrial life go back more than a century. In 1902 the French film director George Milies created the classic silent movie short *A Trip to the Moon*, which featured Moon men encountered by astronauts from Earth. Aliens have become more and more part of the culture of our present-day world. Whether friendly or hostile, it seems that aliens are everywhere in the universe of science fiction. ET is stranded by his mother ship and is cared for by a group of children, while the aliens of *Prometheus* are cosmic engineers of life. You can be a cowboy, a group of children on a London estate, or science fiction nerds on a trip across America, and you will encounter aliens.

Indeed supreme in portraying a galaxy bursting with alien life is *Star Trek*. First broadcast on 8 September 1966, Gene Roddenberry's vision 'to boldly go' to seek out new life and new civilizations has, through a number of spin-off series and movies, led to an encounter with more than 350 different species. One of the most interesting features of the first series was the role of Leonard Nimoy as the Vulcan science officer, Mr Spock. The television network executives were very doubtful about having an alien on board, but he became the focus of public enthusiasm for the series. Indeed, alongside the elements of galactic soap opera and imaginative technology, aliens became a central part of the appeal.

The theologian Thomas O'Meara is quite dismissive of such things. He writes of science fiction: 'Theology need not spend much time on these images, for they are entertainment', and then goes on to say that not much science fiction alludes to religion (O'Meara, 2012: 34). However, there has been a major movement in theological thinking in the last two decades, recognizing not only the religious connections of popular culture but also the way that science fiction exposes through its stories fundamental issues of science and theology (Consolmagno, 1996; May, 1998; Alsford, 2000; Wilkinson, 2000; Detweiler and Taylor, 2003; Oswalt, 2003; Lynch, 2005; Lynch, 2007; Cowan, 2010). Some years ago, Cooper and Skrade pointed out the way that film can charm, enlighten, and disturb us (Cooper and Skrade, 1970). It can expand the imagination in both science and theology.

The world of science fiction has continually expanded and shaped the public imagination in ways that at times have been beneficial for SETI and

at times have been misleading. Concepts such as warp drive give a sense that interesting new civilizations can be reached within the time-scale of a TV programme or a movie. A Milky Way generously populated by alien life, from aggressive Klingons to cuddly Tribbles, forms the picture that the Universe is teeming with life, all wanting to be in contact.

In fact, such pictures may provide false hope for SETI. The distances between the stars are vast and provide a major obstacle to contacting ETI or even knowing that there might be something interesting around another star. When astrophysicist Carl Sagan came to write his novel *Contact* he wanted to explore how an extraterrestrial message could be received and what its effects would be, including how it might be received by the world religions (Sagan, 1988). To move the narrative forward, however, he wanted some kind of meeting between humans and alien beings, but the vast distances would be a major problem. This led to some speculative science. Sagan asked colleagues Thorne, Morris, and Yurtsever to consider whether it was possible to overcome this problem by space travellers crossing the vast distances of the Universe by means of 'wormholes'. Since the 1930s it had been known that the equations of General Relativity allowed the possibility of very small 'tunnels' linking one black hole with another black hole somewhere else in the Universe. Thorne, Morris, and Yurtsever found that under special circumstances such wormholes could allow the possibility of travel (Morris *et al*., 1988). You could enter a black hole in one part of the Universe and emerge elsewhere. It is fair to say that such a possibility is not universally accepted, and there are two major problems. First, the intense gravitational forces around a black hole may 'spaghettify' space travellers before they even reach the event horizon, and second, the theory may be fully confirmed only if someone were prepared to test it. The problem, of course, is that if the theory is wrong, it is a one-way trip into a black hole. It is therefore unlikely that there would be a lot of volunteers!

Another aspect of science fiction, especially in movies and on television, is that the aliens on the whole are pretty much like us. Rick Berman, executive producer of the various *Star Trek* spin-off series, comments: 'We can come up with hundreds of different aliens, but the attractive thing about *Star Trek* is familiarity' (Sekuler and Blake, 1998).

These may be the questions of science fiction, but we will meet them later as we assess the scientific arguments. How might we communicate or know of the existence of ETI across vast distances? How widespread might intelligent life be within our own Galaxy? And how like or unlike us might intelligent life be elsewhere in the Universe? These might be the fun of science fiction, but they are central questions to the science.

## 1.2 Science and the Media: Understanding the Universe from a Piece of Rock

If science fiction has given a particular context as the public looks at the issue of SETI, the news media also provide opportunities and challenges.

In August 1996, news outlets around the world went wild about Allan Hills 84001. Weighing 1.9 kg, and found in the location of Allan Hills in Antarctica in 1984, meteorite ALH 84001 contained pockets of glass which carry the same gases that constitute the atmosphere of the planet Mars. They are sufficiently different from the atmosphere of the Earth to suggest that the rock itself was once part of the martian surface. It was crystallized from magma on Mars and then ejected from the planet due to an asteroid impact some 16 million years ago. It is one of eleven such meteorites that are believed to have come from Mars as a result of this kind of process. Mars material is, in fact, quite abundant. Some 500 tons falls on the Earth each year. In 1911 a piece of Mars known as the Nakhla meteorite fell to Earth in Egypt, and killed a dog.

ALH 84001 wandered the inner Solar System until 13,000 years ago, when it entered the Earth's atmosphere and landed in Antarctica. It was discovered in 1984, and in 1996 a team of NASA scientists led by Dr David McKay published a claim to have found evidence inside the meteorite of long-dead microbes. They identified fine-grained magnetite and iron sulphide particles which are similar to those produced by bacteria on Earth. In addition, tiny spheres of carbonate materials were argued to be further evidence of biological byproducts. Television and newspapers presented pictures showing worm-like structures no more than a hundredth of the diameter of a human hair, with the claim that this was a fossil of a martian bacterium. The British *Daily Mail* called it 'virtually nothing but a vague orange-coloured smudge'!

Yet this 'smudge' led to worldwide headlines of 'we are not alone'. President Clinton hailed the discovery in the following way:

> *Today, rock 84001 speaks to us across all those billions of years and millions of miles. It speaks of the possibility of life. If this discovery is confirmed, it will surely be one of the most stunning insights into our Universe that science has ever uncovered. Its implications are as far-reaching and awe-inspiring as can be imagined. Even as it promises answers to some of our oldest questions, it poses still others even more fundamental. We will continue to listen closely to what it has to say as we continue the search for answers and for knowledge that is as old as humanity itself but essential to our people's future. (Clinton, 1996)*

It is worth noting that he did not enter into the details of what those old and fundamental questions might be! Yet the language is dramatic, and shows the kind of reception that will be part of any claim that SETI has been successful.

The then NASA Administrator Dan Goldin said that public excitement about this field of SETI 'is beyond belief'. One can understand the interest in this. Paul Davies commented:

> *Even the discovery of a single extra-terrestrial microbe, if it could be shown to have evolved independently of life on Earth, would drastically alter our world view and change our society as profoundly as the Copernican and Darwinian revolutions. It could truly be described as the greatest scientific discovery of all time… it is hard to see how the world's great religions could continue in anything like their present form should an alien message be received. (Davies, 1995: xi)*

Here science and religion are coming together in a news story about a piece of rock. Yet this incident is a cautionary tale. It was difficult to see in the headlines the difference between the discovery of little green men and women being found on Mars and the possible discovery of fossilized leftovers that could have been produced by primitive life. This tendency to make an inevitable link from primitive to intelligent life is often seen in SETI.

Furthermore, assessing the evidence is often very difficult for the media to represent. As the team responsible for the claim has admitted, the evidence so far is not compelling proof. In the original paper in *Science*, they make clear that every feature of ALH 84001 can be explained by itself simply without the idea of life on Mars (McKay *et al*., 1996). Indeed, a great number of the scientific community have discounted the claim of fossil life, arguing that the structures, taken by the NASA team as evidence of life, can be explained by non-biological chemical or mineralogical processes (Rothery and Zarnecki, 2011: 116–120). This would point to another formation mechanism rather than microbes. Yet these arguments have not made the front pages of the *Daily Mail.*

In addition, even if there is evidence for fossil bacteria, can we be fully sure that they evolved on the surface of Mars? It is not impossible that bacteria could have entered the rock during its time on Earth, though the fact that they are deep inside makes this unlikely. Another possibility, also unlikely but not to be ruled out, is that the rock was on its second leg of a round-trip ticket to Mars. The rock could have initially been ejected from the Earth by the same mechanism which ejected it from the surface of Mars. Micro-organisms can survive quite lengthy journeys in space,

provided they are concealed deep in rocks. We may be simply seeing a primitive organism which evolved on the surface of the Earth and which has gone on its own space journey. One of the big questions for the discovery of life on Mars is whether it has arisen independently, or whether the Earth and Mars form their own 'biosphere'.

It is interesting to note that the concept of life being carried through space by meteorites is not new, being proposed by Lord Kelvin in the nineteenth century. Nor are claims of life on Mars a new idea. In 1877 the Italian astronomer Giovanni Schiaparelli reported the existence of dark lines on the surface of Mars. He described these lines as 'canali', which means 'channels' but was misunderstood in English as 'canals'. As a result, a century ago Percival Lowell built his own observatory in Arizona to look for life on Mars. He observed the surface of Mars and saw patterns which changed. He identified such changes with life. The belief grew that the canals were built to bring water from the polar ice caps to the vegetation of the equatorial regions—a belief that was later shown to be mistaken.

Nevertheless, fuelled by interest in the question of life on other planets, NASA's Curiosity rover is exploring the surface of Mars. From its landing site—interestingly named after science fiction author Ray Bradbury—it will analyse dozens of samples drilled from rocks or scooped from the ground, investigating whether the area has ever had or still has environmental conditions favourable to microbial life—both its habitability and its preservation. It carries a payload more than ten times as massive as those of earlier Mars rovers. The crater was selected on the basis that it had exposures of minerals formed under wet conditions. While there are no artificial canals on Mars, early in its history the planet did have water on the surface. The three conditions believed to be crucial for the possibility of life are liquid water, certain chemical ingredients, and a source of energy. Every environment on Earth where there is liquid water sustains microbial life. Thus, since the mid-1990s NASA has adopted the strategy of 'following the water' in the search for extraterrestrial life.

This mission, costing $2.5 billion, is only a small part of the exploration of Mars. So far, since the 1960s, more than forty missions have been sent to Mars. In the more recent period, the Pathfinder mission (1996–98) landed its Sojourner rover, returning results which suggested that early in its history Mars may have had liquid water on its surface and a thicker atmosphere. The photographs of the martian surface were stunning, and the technical feasibility of reasonably low-cost missions to Mars was proved.

In 2001, Mars Odyssey began its orbital mission which would lead to strong evidence for large quantities of frozen water mixed into the top layer

of soil in regions of the planet near its north and south poles. Mars Exploration Rover Spirit (2003–10) saw a large number of rocks and soils which had been exposed to water. In particular, it happened upon a deposit of nearly pure silica, indicating that in this location there were hot springs or steam vents. This is significant, as on the Earth these environments are full of microbial life. The discovery of primitive forms of life here on Earth which live in volcanic hot springs and around ocean thermal vents has been important in suggesting that life can evolve and be sustained in rather harsh conditions. It seems possible that such conditions existed on Mars, and so life could have developed in a similar way. As time went on, the organisms may have retreated deep into rocks or deep below the surface. The real difficulty is that to find them the probes would have to drill from 100 metres to 1 kilometre under the surface.

These indications of a very different Mars earlier in its history were strengthened when in 2004 the Mars Exploration Rover Opportunity landed and showed that the composition and textures of some rocks demonstrated that they had been saturated with water and perhaps been laid down under gently flowing surface water. Mars Express and Mars Reconnaissance Orbiter continue to analyse the planet from orbit, while Phoenix Mars Lander, as well as observing falling snow, found soil chemistry that could be interpreted as advantageous for life. Taken together these missions have suggested a sequence of globally distributed water environments very early in Mars' history, moving from less to more acidic environments, as well as indications of the presence of methane.

In early 2012, NASA, affected by new funding constraints, announced its strategy for future exploration of Mars. Ideally this will comprise orbiters that view the planet from above and act as telecommunications relays, supplemented by surface-based mobile laboratories, robots that probe below the planet's surface, and ultimately missions that return soil and rock samples to Earth and prepare for human landing.

However, this all depends on the appetite of the public and politicians to continue investing in the exploration of Mars. It has been cynically suggested that ALH 84001 came just at the right time to retain interest in Mars and future missions. This is too simplistic, but there is something in the way that science needs to be in the news to keep its funding priorities.

Yet, back to the significance of life being found on Mars. Would it be one of the most 'stunning insights' that science has given us? Maybe or maybe not! Even if life did begin on Mars at the same time as it did on Earth some 3,800 million years ago, as Mars started to freeze, living organisms may have retreated into rocks or into the planet's interior, seeking

warmth from volcanic hot springs. The surface conditions are just not able to sustain life. Mars is too dry, any water being frozen in permafrost, and intense ultraviolet radiation bathes and sterilizes the surface.

What, then, would be the importance of finding primitive life that we could be sure had evolved independently of Earth on another planet? In the case of Mars, if confirmed, it would suggest that the process which forms life is widespread throughout the Universe. To find evidence for life on one of our closest neighbours which has a very harsh environment means that life can develop in far more diverse circumstances than we had imagined. It is rather like coming back from a shopping trip having been told by the seller that the article you have purchased is rare and difficult to acquire—only to find that all your neighbours have the article as well!

However, there is another important lesson from Mars. If primitive life is confirmed it also shows that life does not necessarily develop to intelligent life. We shall need to return to this question throughout the book. For science fiction to be interesting, it always needs to deal with intelligent, self-conscious life out there in the Universe. To simply boldly go to seek even more bacteria is not really gripping drama. The same is true for science and theology.

## 1.3 Science and Religion: The New Mythology of a Place among Aliens

Ridley Scott's movie *Prometheus*, as well as giving the back story to the *Alien* movies, also embeds a story of a quest for the origin of human beings and indeed creator gods. The link between extraterrestrial intelligence and a religious quest has had a significant time in the last hundred years, with various new religious movements built on the mythology of aliens (Alnor, 1998; Bader *et al*., 2010; Lewis, 2003; Reece, 2007; Battaglia, 2005; Hammer and Rothstein, 2012).

Some of these new religious movements are often the source of mockery and fun. In 1914, London taxi driver George King was washing some plates when he heard the voice of the Interplanetary Parliament which appointed him as a prophet. King channelled messages from alien beings and apparently defended the world against a plot by the Evil Fish Fiends from Garouche to suck out the atmosphere of the Earth. Then the International Raelian Movement was founded by racing driver Claude Vorihon in 1973. He told of how he had encountered an alien who appointed him as prophet to the world.

However, there are other religious movements which have become far more influential. The Church of Scientology has drawn a lot of attention, in large part because of the involvement of celebrities such as Tom Cruise. Its history weaves together science fiction, religion, and belief in aliens. In the late 1940s a group of science fiction writers met together to discuss what would be a successful modern religion in contrast to the traditional religions. One of that group was the well-known science fiction author L. Ron Hubbard. Hubbard went on to found such a religion, the Church of Scientology, which blends a successful method of psychotherapy, called 'Dianetics', with a mythology of aliens. Each human body is inhabited by a spiritual immortal entity called a Thetan. The Earth is a prison planet where Thetans are being dropped off by flying saucers from wars in the Galactic Federation. The distinction between science and science fiction is blurred, but provides a powerful mix.

Far more seriously, the combination of religion and aliens led to the death of thirty-nine people in a mansion near San Diego in 1997. Laid out on their backs on bunk beds and mattresses, dressed in black, faces hidden by purple shrouds, they had left identification papers and goodbye messages through video and the Internet. They died through a combination of drugs, alcohol, and plastic bags over their heads. These members of the Heaven's Gate cult led by a former music professor Marshall H. Applewhite committed mass suicide as a result of bad science, the Internet, and religious beliefs (Steiger and Hewes, 1997; Chryssides, 2011).

The story begins with comet Hale–Bopp, named after the two amateur astronomers who discovered it on 23 July 1995. It was probably the most viewed comet of recent history, bright for over a month high in the evening skies over the northern hemisphere. Despite its brightness it came no closer than 200 million kilometres from the Earth. Many theories abound as to comets bringing either death or life. Some argue that a comet impact was responsible for the extinction event 65 million years ago which claimed the dinosaurs. Others see comets bringing to worlds like the Earth the carbon-based molecules necessary for life.

However, for the members of Heaven's Gate, comet Hale–Bopp was something completely different. They took the comet as a sign to commit mass suicide, as they believed that there was an alien spaceship following behind the comet and using it as a shield. In November 1996 an amateur astronomer, Chuck Shramek, claimed that he had photographed an object following in comet Hale–Bopp's wake. This connection was pushed widely on the Internet, with photographs apparently showing the UFO. The Heaven's Gate cult took this to be their 'suicide' spaceship. In fact, it was nothing more than a background star.

They saw themselves as beings from another planet simply inhabiting the 'containers' of human bodies. Through committing suicide their immortal souls would be released and taken by the spaceship to the Kingdom of Heaven. They saw comet Hale–Bopp as 'Heaven's Gate'.

The Heaven's Gate cult was not alone in this kind of belief. Since 1994, seventy members of the Order of the Solar Temple took their lives in Europe and Canada. They believed that ritual suicide leads to rebirth on a planet called Sirius.

The Heaven's Gate cult displayed once again a powerful mixture of religion, science fiction, and the belief in aliens. Their website attracted surfers looking for anything between alien abductions and the second coming. They mixed end-of-the-world eschatology with a space alien obsession, ridiculing Christianity but using biblical references alongside a fascination with the aliens and terminology of *The X-Files, ET, Star Wars*, and *Star Trek*.

With science fiction, news coverage of Mars, and twentieth century cults, the impression could be given that this fascination with other worlds and this entanglement of alien speculation and religious themes is a very recent phenomenon. However, this is far from the truth, as the next chapter will suggest.

# 2
# Speculating about a Plurality of Worlds: The Historical Context of Science, Religion, and SETI

The history of speculation about life on other worlds has been well documented, but is generally not well known (Crowe, 1986; Crowe, 2008; Dick, 1982; Dick, 1996; Dick, 1998; Guthke, 1990; Basalla, 2006; Kukla, 2010). This body of literature counters the widespread belief that SETI is a very recent phenomenon of the last fifty years. While the 'search' pursued by strict scientific methods did not really begin until the era following the Second World War, speculation about extraterrestrial intelligence has a much longer history. Another widespread view, also mistaken, is that religious thinkers and the religious establishment have always reacted to such thinking in a 'Giordano Bruno burning at the stake' kind of way. The historical evidence gives a very different picture, including Bruno's case. It shows the important part that religion has played in shaping such speculation and also the way that religion has been challenged by such speculation.

Again, while I will focus on the relationship between Christianity and ETI, it should be noted that this was not the only interaction. For example, the thirteenth-century philosopher Teng Mu said, 'How unreasonable it would be to suppose that besides the heaven and Earth which we can see, there are no other heavens and no other Earths' (Needham and Wang, 1954: 221). Later in the fifteenth century the Muslim astronomer Ulugh Beg opined that the words of the Koran suggested that God has spread living creatures in both the heavens and the Earth. As with the whole of the science-and-religion dialogue, Christian theology is only part of a much bigger picture.

## 2.1 Atomism and Plenitude

Speculation about other worlds has been motivated by a number of different influences, but throughout its history there has been a strong religious

component. While in the sixth century BC Anaximander and Anaximenes of Miletus discussed a plurality of worlds, a number of scholars date the beginning of serious interest to Plato and Democritus.

Plato (427–347 BC) argued that the maker of the Universe 'distributed souls equal in number to the stars, inserting each in each' (Plato and Taylor, 1793). He believed that if anything could be created it was created by the demiurge who built the Universe. Plato's demiurge was not the sole Creator of all things, but simply an entity who worked with pre-existing matter as an architect of the Universe. It is interesting to note that such a view, as we shall see, has its advocates today, though they express it in a different form.

The philosophy of atomism, rather than a demiurge, provided a basis for Democritus (450–361 BC) to believe in other worlds. According to this, the world was made by the coming together of constantly moving 'atoms'. As nothing was special about this in the case of the Earth, then this could happen in many different places. Such a philosophy in many ways still undergirds the belief in life elsewhere in the Universe. It combines three assumptions about the Universe:

- The laws of nature are universal.
- There is nothing special about the Earth.
- If something is possible then nature tends to make it happen.

The result of this combination is that you quickly arrive at the conclusion that we are not alone in the Universe. Atomism achieved such a combination. In the constant moving and coming together of atoms in an infinite number of ways, which was thought was true for the whole of the Universe, then every possible outcome was fulfilled. Life on the Earth had arisen as just one example of many. Following this line also, Epicurus (341–270 BC) wrote: 'There are infinite worlds both like and unlike ours . . . we must believe that in all worlds there are living creatures' (Rist, 1972).

However, key to this argument is the coupling together of atomism with the added understanding that atomism fulfils all possibilities. Crowe has suggested that this view of the world adopts 'the Principle of Plenitude' (Crowe, 1997: 148), described by Lovejoy as 'no genuine potentiality of being can remain unfulfilled, that the extent and abundance of the creation must be as great as the possibility of existence and commensurate with the productive capacity of a "perfect" and inexhaustible "Source" and that the world is better, the more things it contains' (Lovejoy, 1936: 52). Of course, such a 'Source' could be randomness or it could be divine activity.

This means that the philosophical consideration of the possibility of other worlds is at least 2,500 years old. Alongside the possibility, many also speculated about the nature of life on other worlds. The Pythagoreans of the fifth century BC believed that the Moon was inhabited by creatures vastly superior to those on Earth. This belief survived in scholarly debate until the eighteenth century. Plutarch (46–120 AD) first called the dark areas of the Moon's surface 'seas', and such names are still retained today, featuring in the Apollo 11 landing on the Sea of Tranquillity. In the first century BC the Roman philosopher Lucretius suggested: 'In the Universe, nothing is only one of its kind. In other regions, surely there must be other Earths, other men, and other beasts of burden' (Lucretius Carus and Copley, 2011).

## 2.2 The Infinite Power of God and the Centrality of Man

Following such speculation, early Christian theologians such as Origen (*c.*184–254) saw a variety of creatures in the Universe (O'Meara, 2012: 66–7; Scott, 1991: 133; Crouzel, 1989). Other theologians were a little more restrained. John Chrysostom, Athanasius, Basil, and Ambrose in the fourth century had no problem with God creating other worlds, but were hesitant about whether he had done so. This illustrated a fundamental tension which was to run through Christian engagement with the subject. That is, the power of God should not be limited, but how can human uniqueness be maintained?

Thomas Aquinas (1225–1274) synthesised Christian doctrine and Aristotelian cosmology. This cosmology established the centrality of the Earth and indeed the special place of human beings. This discouraged strongly the idea of other worlds. However, this can be pushed too far. As George comments:

> *On the one hand, the human species would reflect God's goodness in a special way by being unique, while, on the other hand, it is befitting to God's goodness that he create more of better creatures. Aquinas leans in the direction of the former view, but realizes that the latter could in fact be the case. (George, 2001: 257)*

Indeed, O'Meara goes further, arguing that in the long term Aquinas' insights encouraged thinking about SETI, as God is seen as the creator–artist whose goodness pours forth in the diversity of creation (O'Meara, 2012: 71).

Although in the short term Thomist theology discouraged thinking about a plurality of worlds, it was soon to come under attack concerning whether it limited too much the omnipotence of God. In 1277 the Archbishop of Paris, Étienne Tempier, was asked to look into ideas drawn into Christian belief from Aristotle that might be dangerous to faith. He issued a condemnation of 219 propositions that he considered too restrictive of divine omnipotence, including that God could not make several worlds (Wippel, 1995).

The reaction against Aristotelian ideas opened up the space for several theologians to discuss the possibility of a plurality of worlds. Basing his opinion on Augustine's idea that God could have made a perfect man, William of Ockham, the fourteenth-century Oxford Franciscan, declared it probable that God could create a better world than ours, and was certain that he could create an infinite number of worlds identical to ours. But raising the possibility of a plurality of worlds was very different from suggesting that there actually were populated other worlds.

Although it became heretical to deny that God could create other worlds, it was dangerous to claim that he had. Nevertheless, in the fifteenth-century Cardinal Nicholas of Cusa not only recognized that the Universe can have no centre, but also suggested the possibility of other Earth-like planets, including more illustrious extraterrestrials close to the Sun and lunatics on the Moon (Brooke, 1991: 62–3). Nicholas also made a key theological move. As O'Meara recognizes, for Nicholas 'it is not physical centrality that enhances the planet Earth and humans but their relationship to the Creator of the vast Universe' (O'Meara, 2012: 76).

Franciscans such as Bonaventure and Guillame de Vaurouillon (*c*.1392–1463) stressed that God could make other worlds (McColley and Miller, 1937). Crowe says of de Vaurouillon that he was the 'first author who raised the question of whether the idea of a plurality of worlds is compatible with the central Christian notions of a divine incarnation and redemption' (Crowe, 1997: 149). De Vaurouillon speculated that other life on other planets would not be affected by sin, as they would not be descended from Adam. He then moves on to the incarnation:

> *As to the question whether Christ by dying on this Earth could redeem the inhabitants of another world, I answer that he was able to do this even if the world were infinite, but it would not be fitting for Him to go unto another world that he must die again. (McColley and Miller, 1937: 388)*

As we have seen, it is often quoted that Giordano Bruno was the first martyr for extraterrestrial belief. Born in 1548, he was burned at the stake for

heresy in the year 1600 after a lengthy trial. However, as often is the case, the history of the dialogue of science and religion is often more complicated than many would present. Bruno was a staunch supporter of Copernican theory. As Butterfield put it, Copernicus (1473–1543) closes the era of the dominance of Aristotle (Butterfield, 1949). Although local Lutheran pastor Osiander added a preface to *On the Revolutions of the Celestial Spheres* to suggest that Copernicus was simply providing a calculating device rather than telling us directly about the nature of the world, many saw it as dethroning the Earth from the centre of the Universe and opening up the question of whether there might be other planets elsewhere in the Universe.

There is considerable debate about whether Bruno was more influenced by Copernican theory or by the atomism of Democritus and Epicurus, or by the belief in the omnipotence of God. It is probable that all three were at work, showing that science, philosophy, and theology were interlinked in speculation about other worlds. What we do know is that Bruno was not condemned solely for belief in other worlds. More serious were his practice of magic and his denial of the divinity of Christ.

At this period of history, the subject of life on other worlds found itself in the midst of changing views of the Universe and also changing views of authority within the Church. The Reformation emphasis on the authority of Scripture was used in a number of different ways. In 1578, Daneau stated that the idea of life on other planets should not be accepted since it was not taught in Scripture (Daneau and Twyne, 1578: 22). However, a deeper argument was going on in the battle over whether the Church should hold onto Aristotelian cosmology.

Nineteenth-century authors such as A. D. White popularized the story that Protestants opposed Copernican theory because of the Bible (White, 1896). This is vastly overstated. There is little evidence of opposition from Luther, and Calvin's objection when he denied a moving Earth seems to have been an argument not based on Scripture but on common sense. Philip Melanchthon, however, did employ the Bible in attacking Copernicus. He used passages such as Psalms 119:90, which speaks of God establishing the Earth, but it does seem clear that his main concern was to defend an Aristotelian cosmology. This centrality of the Earth then becomes part of his argument against the plurality of worlds. Coupled with this was his argument that

> *The Son of God is One; our master Jesus Christ was born, died, and resurrected in this world. Nor does he manifest Himself elsewhere, nor*

> *elsewhere has he died or resurrected. Therefore it must not be imagined that Christ died and was resurrected more often, nor must it be thought that in any other world without the knowledge of the Son of God, that men would be restored to eternal life. (Dick, 1982: 89)*

For Melanchthon it was inconceivable that the life, death, and resurrection of Jesus would be reproduced elsewhere. If this was the case then there was no way that life on other worlds might attain eternal life apart from knowledge of Christ. In addition, Melanchthon believed that when Genesis stated that God rested on the seventh day, this ruled out his working on other worlds (Brooke, 1991: 97).

Of course, it was Galileo Galilei (1564–1642) who gave fresh impetus to the Copernican view of the Universe following his observations of the moons of Jupiter and the phases of Venus. Yet he showed considerable caution in his *Dialogues Concerning the Two Chief World Systems* (1632) when discussing the possibility of whether the Moon and planets were inhabited. His friend Ciampoli warned him against such speculations, since it would invite awkward questions about how the descendants of Adam and Eve reached the Moon (Brooke, 1991: 105).

Johannes Kepler (1571–1630) was much less cautious. Observing the surface features of the planets and the Moon, he speculated that the Moon's inhabitants were stronger than ourselves because of the long, hot lunar days. He also argued from Galileo's observation that Jupiter had moons that it too must be inhabited. He reasoned that as the Moon had been made for our benefit by God, then the moons of Jupiter were made for the benefit of the inhabitants of Jupiter. So then there must be inhabitants! Yet for Kepler, human beings remained the 'predominant creature' in the Universe.

Meanwhile, in England, Copernicanism had taken root, most passionately in John Wilkins (1614–1672), an English clergyman, one of the founders of the Royal Society, and later Bishop of Chester. In 1638 he published *Discovery of a World in the Moone*, arguing for life on the Moon (Wilkins, 1972). He took the silence of Scripture not as a ban, but as an invitation to consider the possibility of other worlds. He suggested that intelligent beings on other worlds need not be like humans fallen from grace; but even if they had, Christ could have died for them also (Brooke, 1991: 88–9).

At this stage, arguments about the centrality of the Earth and the power of God were beginning to be supplemented by arguments about the Bible and how widespread was the work of redemption in Jesus. But underneath all of this a very important move was being made. In a sermon in Florence

in 1614, Tommaso Caccini had attacked Galileo, saying that he opposed Scripture. It is reported that he echoed the words of Acts 1:11: 'Ye man of Galilee, why stand ye gazing up into heaven?' It was a clever play on words, but ironically summed up a much deeper threat. The era that Galileo was bringing in was an era where the world was not to be understood primarily by philosophical speculation but by empirical observation—by gazing at the heavens with the instruments of modern science.

Spradley notes that by the end of the seventeenth century the idea of other worlds had become more widely accepted, but with a decreasing emphasis on the doctrine of redemption (Spradley, 1998). Fontenelle (1657–1757) became an influential voice in the area with the publication of his *A Plurality of Worlds* (Fontenelle and Glanvill, 1688) and a number of follow up publications (Fontenelle, 1715; Fontenelle, 1737). Lovejoy suggests that he shifted theological attention from the Earth to the vastness of the Universe and the belief in many worlds (Lovejoy, 1936: 131).

The theme of the vastness of the Universe then became a central argument for the existence of life on other worlds in the thinking of Richard Bentley (1662–1742) in England and Christiaan Huygens (1629–95) in Holland. It was now clear that their scientific work was showing that there were vast numbers of other stars apart from our Sun in the Universe. On the basis of this, they reasoned that if there were stars which were unable to be seen from the Earth, then how would God's glory be shown by this part of creation? The solution was that these stars must have been created for the benefit of other civilizations that could see them. Therefore, there must be other intelligent life. Alongside this, the historian of science Colin Russell has suggested that common to the many speculations about other worlds in the seventeenth century was an insistence on God's ability to create life anywhere he wished and that the Universe existed not just for the sole benefit of human beings but to exhibit His glory to all (Russell, 1985b: 52). Huygens wrote:

> *That which makes me of this Opinion, that those worlds are not without such a Creature endowed with Reason, is that otherwise our Earth would have too much the advantage of them, in being the only part of the Universe that could boast of such a Creature. (Huygens et al., 1698)*

The success of Newton's law of universal gravitation indicated that all parts of the Universe were governed by the same natural laws. Other stars, therefore, might have their own planets. But the laws of gravitation also gave us an early version of the anthropic principle. English theologian Robert

Jenkin showed openness to inhabited planets but also tried to understand why God may have created uninhabited worlds:

> *I observe, that though it should be granted, that some Planets be habitable, it doth not therefore follow, that they must be actually inhabited, or that they ever have been… And since the fall and mortality of mankind, they may be either for mansions of the righteous, or places of punishment for the wicked, after the resurrection… And in the meantime, being placed at their respective distances, they do by their several motions contribute to keep the world at a poise, and the several parts of it at an equilibrium in their gravitation upon each other, by Mr Newton's principles. (Jenkin, 1700: II.222)*

In the eighteenth-century, astronomers such as Thomas Wright (1711–1786), Johann Lambert (1728–1777), and William Herschel (1738–1822) continued the relationship of science, religion, and the plurality of worlds. Herschel claimed evidence for life on the Moon and the Sun. Johann Bode (1747–1826) gave some theological support for these 'solarians', suggesting that as God fills the Earth's natural world with diverse life, so he will not let the vast space of the Sun to be without life ready to praise the Creator.

In this, astronomers were not alone. Enlightenment intellectuals, from poets such as Edward Young and Friedrich Klopstock to philosophers such as Immanuel Kant and Voltaire, exhibited the widespread belief in the plurality of worlds. Yet still, in thinking about the theological relationship, creation prevailed over redemption. Alexander Pope's *Essay on Man* (1734) expressed the spirit of the day with its faith in other inhabited worlds:

> He who thro' vast immensity can pierce,
> See worlds on worlds compose one universe,
> Observe how system into system runs,
> What other planets circle other suns,
> What vary'd being peoples ev'ry star,
> May tell why Heav'n has made us as we are (Pope, 1951: I.lines 23–28)

This age was also the time when the popularity of the design argument was at its height, with scientists seeing the world in all its intricate detail pointing to the care of a perfect designer. John Ray argued for the designer God to be seen in the construction of a fly's eye. In believing that the vast diversity of species on the Earth demonstrates the wisdom of God, it was not surprising that he made the same case for life on other planets. This could also be used to contemplate God's wisdom and power in creation (Ray, 1743: 368–9).

Thus some saw extraterrestrials as evidence of God's creative powers, while others argued that the creative effort God put into this vast Universe would have been wasted if life were confined to the Earth. Yet others used the existence of life elsewhere in the Universe to present a bigger perspective on human life. In 1757, Benjamin Franklin, the inventor of the lightning conductor, when he heard that the world might one day collide with Halley's comet, said: 'We must not presume too much on our own importance. There are an infinite number of worlds under the divine government, and if this was annihilated, it would scarce be missed in the Universe' (Crowe, 1986: 109).

Why had such speculations become so respectable? We can draw together a number of influences. First, prior to the Copernican revolution, human beings considered themselves to be the centre of everything. The Universe as described by Aristotle and Ptolemy had the Earth as its centre and everything orbiting around in beautiful (but increasingly complex) circles. Men and women were the masters of it all. But the dethronement of human beings opened up the space for belief in ETI. The Copernican revolution was in turn dependent on the overthrow of Greek thought and the mediaeval theology which was so coupled to it. The influence of Judaeo-Christian theology on this should not be underestimated. A number of historians of science have pointed out the way that Christian theology demystified nature, and led to the experimental method. Although sometimes this can be overstated, nevertheless belief in a God who freely creates the Universe and welcomes the enquiring mind gives a strong basis for the empirical method (Whitehead, 1925; Foster, 1934; Collingwood, 1940; Needham, 1970; Hooykaas, 1973; Harrison, 1998). Thus Bentley, Huygens, and others were set free to use observations of the world as the primary basis of science. And observing such a vast Universe raised the real possibility of other inhabited worlds.

Second, as Russell has pointed out, the decoupling of physical position and actual status of human beings was a major influence (Russell, 1985a). In the Aristotelian Universe, position and status were closely associated. We were special because we were placed at the centre. In contrast, the Bible does not associate status and place. The dignity and worth of human beings comes from the gift of relationship with God. The problem of the devaluing of human beings by moving them away from the centre of everything could be countered by this view.

Third, science was uncovering laws that had seemed to apply in every part of the Universe. The assumption grew that the processes which led to life were universal as well. The laws were universal, and we were no longer special just to the Earth. Therefore, it was quite reasonable to conclude that

we were not unique. Again, this belief in the laws of nature has been argued to come from biblical understanding of the faithfulness of God in creation. Or to express this another way, scientists looked for scientific laws when they recognized a lawgiver (Zilsel, 1942, Oakley, 1961).

So in all of this, the Bible was occasionally used for 'proof-texts' to try to prove or disprove other intelligent life. However, far more importantly, it was being used to encourage empirical science which led to dethroning human beings from the centre, understanding human value in a different way, and indicating the universality of the physical laws.

## 2.3 Deism and Evolution

At the end of the nineteenth century and into the next, scientists began to become very sceptical about the possibility of other life. There had always been such scepticism; and the pendulum began to swing back to Aristotle and his view that human beings were unique. However, this did not happen before an intense dialogue between the existence of ETI and religious belief, which both challenged Christian theology and gave birth to new religious movements.

At the turn of the century, Thomas Paine (1737–1809) published *The Age of Reason* (Paine, 1795). In this widely read book, Paine argued that ETI made it impossible to believe any longer in the Christian doctrine that God had become a human being and died as an atonement for sin on the cross. Paine was convinced that the scientific evidence pointed to life elsewhere in the Universe, and therefore to believe in a Christian story which was centred on the sin of Adam and Eve and the death of Jesus of Nazareth here on the Earth was 'little and ridiculous'. The more reasonable option was to believe in a remote and impersonal God who started the Universe but then had little room for action within its history—a belief which is often referred to as 'deism'.

The book caused a major stir, selling well on both sides of the Atlantic and provoking a number of attacks (Tytler, 1796; Nelson, 1800; Watson, 1806; Broughton, 1820). Timothy Dwight (1752–1817), President of Yale University, was a fierce critic of deism and repeated 173 sermons every four years for the benefit of each cohort of students. It is of interest how he used the possibility of extraterrestrial life in his arguments. He spoke of the unceasing variety and beauty of multiple worlds showing the greatness of the Creator, and suggested that among the vast number of intelligences either on the Moon or elsewhere it was only on the Earth and among the angels that there was a rebellion against God. Therefore, redemption was

required only for planet Earth. Thus Paine's objection to the anthropocentric nature of Christian redemption was countered on the basis that it was needed only for Earth. Humanity is the only race in the Universe that fell into sin and required redemption (Dwight *et al*., 1818).

Among Scottish evangelicals such as Thomas Chalmers (1780–1847) and Thomas Dick (1774–1857) there was a strong engagement with extraterrestrial themes (Chalmers, 1871). Dick touched on the anthropic principle, pointing out that God placed the orbit of the Earth at just the right distance from the Sun to make life possible. However, he suggested that life could exist on other planets and indeed on the Moon and in the Sun—with suitably adapted life-forms. In addition, he was one of the few to claim that the existence of extraterrestrial life 'is more than once asserted in Scripture' (Dick, 1844: 153).

Outside mainstream Christianity, in a parallel of what happened in the twentieth century, extraterrestrials found themselves mixed into new religious movements. Emanuel Swedenborg (1688–1772), who founded the church named after him, claimed conversations with extraterrestrials. Ellen G. White (1827–1915), the prophetess of the Seventh-Day Adventist Church, had visions of extraterrestrials. Joseph Smith (1805–1844), the founder of the Church of Jesus Christ of Latter-Day Saints (or Mormon Church) advocated the idea that the Universe contains a vast number of inhabited worlds, including some that had already passed away and some that would arise (Loughborough, 1972; Paul, 1992). It is interesting that the response to Paine was an attempt to incorporate extraterrestrials into religious thought. This shows in part how widely held was the belief in the plurality of worlds.

However, Crowe points out how influential Paine became, with his views echoed by US President John Adams, Ralph Waldo Emerson, and Mark Twain, and gives the following fascinating example (Crowe, 1997). In September 1832, Emerson resigned as a pastor due to his theological convictions. Earlier in the year he preached a sermon entitled 'Astronomy', in which he argued that the view of the Universe disclosed by astronomy calls for changes in theological beliefs. In particular, the Copernican revolution meant that the Earth could no longer be seen either as the centre of the Universe or the centre for God's redeeming work. The result was that you could still believe in God but not in the way that Christians had interpreted the death and resurrection of Jesus (Emerson, 1938: 174–5).

However, in the second part of the nineteenth century, voices grew against the idea of extraterrestrial life. In 1853, philosopher and historian of science William Whewell (1794–1866), Master of Trinity College, Cambridge, and

formerly a supporter of other inhabited worlds, published an essay *Of the Plurality of Worlds* (Whewell, 1853). This identified weaknesses in many of the religious and scientific arguments that had been used to support the concept of extraterrestrials. Using the observational evidence that was then accumulating, Whewell pointed out that apart from the Earth none of the other bodies in the Solar System had conditions that would allow life to survive. He set out the force of his arguments as follows:

> *It will be a curious, but not a very wonderful event, if it should now be deemed as blamable to doubt the existence of inhabitants of the Planets and Stars as, three centuries ago, it was held heretical to teach that doctrine. (Whewell, 1853: iii)*

Whewell's tract caused great controversy, which was not unexpected given the widespread belief in other worlds. In particular, there was a strong argument that Mars might support life, which was prolonged by Giovanni Schiaparelli's reported discovery of 'canals' on the martian surface.

However, help was on its way for Whewell. One of the legacies of Darwin's *On the Origin of Species* was the sense of how the evolution of intelligent life depended on delicate conditions. Alfred Russel Wallace, co-founder of the theory of evolution, used the argument of the sheer improbability of the emergence of human intelligence against astronomers searching for signs of intelligent life on other planets, in a book entitled *Man's Place in the Universe* (Wallace, 1904).

Science was now beginning to go against the plurality of inhabited worlds. It was clear that the other planets and moons in our Solar System seemed to be unable to support life. Evolution began to be seen as a very special process with a high degree of sensitivity to the circumstances. Life had developed here on Earth because of very special circumstances. It began to seem that although planets around other stars might exist it was unlikely that they were inhabited.

Even the possibility of planets around other stars began to have problems. Astronomers had begun to think about how planets formed. One option, the nebular hypothesis, suggested that planets formed as the stellar nebular (the gas cloud out of which stars form) collapsed and formed a star. If this was the case then the vast majority of stars would have planets associated with them. This had been proposed by Emanuel Swedenborg in 1734, and was developed by Kant and Laplace. As the nebula contracted, it flattened and shed rings of material which later collapsed into the planets. This model, dominant in the nineteenth century, began to run into difficulties concerning the distribution of angular momentum between the

Sun and planets. This resulted in a concerted move away from such a model and a search for alternatives. One alternative was that planets were formed from material dragged out of one star by a close encounter with another star. This would mean that the number of planets would be very small indeed, as these close encounters are particularly rare.

Crowe notes that by 1917 more than 140 books dealing with the question of extraterrestrial life had appeared (Crowe 1986, 646–57). However, as the early part of the twentieth century developed, the widespread belief in a plurality of inhabited worlds of just a century earlier began to narrow greatly.

Why, then, has the pendulum swung again in the second part of the twentieth century to much more optimistic hopes of SETI? It is to the science which has produced this effect that we turn next, before returning later to the theology.

# 3
# Hubble and Drake: SETI and Cosmology

In 1995 the columnist Bernard Levin echoed an argument that has been widespread in the contemporary discussion of SETI:

> *If you just think for a moment about those vast numbers of other worlds you should be rocking with laughter if anyone suggests that the Universe is peopled only by us. (Levin, 1995)*

On the basis of this kind of argument, Frank Drake, radio astronomer and one of the founding fathers of SETI, suggests:

> *I do not wonder whether we shall detect another civilization. I wonder when. The silence we have heard so far is not in any way significant. We still have not looked long enough or hard enough. (Drake and Sobel, 1994: 233)*

Even without any visit or contact from ETI, this basic argument about the vastness of the Universe is very compelling. Yet not everyone is persuaded. Marshall T. Savage is convinced that the odds against the appearance of life are just too great for the event to have occurred more than once. He comments:

> *The skies are thunderous in their silence; the Moon eloquent in its blankness; the aliens are conclusive by their absence. They've never been here. They're never coming here because they don't exist. (Savage, 1995: 41)*

In fact, Savage is an advocate of space travel who wrote *The Millennial Project: Colonizing the Galaxy in Eight Easy Steps*, and sees human expansion into space as the way the Universe will be redeemed:

> *Teetering here on the fulcrum of destiny stands our own bemused species. The future of the Universe hinges on what we do next. If we take up the*

> *sacred fire, and stride forth into space as the torchbearers of Life, this Universe will be aborning. If we carry the green fire-brand from star to star, and ignite around each a conflagration of vitality, we can trigger a universal metamorphosis. Because of us, the barren dusts of a million billion worlds will coil up into the pulsing magic forms of animate matter. Because of us, landscapes of radiation blasted waste, will be miraculously transmuted. Slag will become soil, grass will sprout, flowers will bloom, and forests will spring up in once sterile places. Ice, hard as iron, will melt and trickle into pools where starfish, anemones, and seashells dwell—a whole frozen Universe will thaw and transmogrify, from howling desolation to blossoming paradise. Dust into Life; the very alchemy of God. (Savage, 1994:15)*

Such a disagreement is characteristic not only of popular science writing and the media but also of the divergence of the scientific community on the question of extraterrestrial life. Those who argued for it strongly in the modern period tended to be astronomers and physicists (Shklovskii and Sagan, 1966; Drake, 1962). Those who argued against it tended to be the leading experts in evolutionary biology. They suggested that because the emergence of intelligence is very unlikely, humanity is probably unique (Dobzhansky, 1972; Dobzhansky, 1973: 99; Simpson, 1964; Mayr, 1978; Jacob, 1977).

In these coming chapters we will need to sift and then assess the various scientific arguments both for and against whether SETI will be successful. Before we move to detailed considerations about exoplanets (planets outside the Solar System) and the origin of life, it is worth looking at some of the factors from the Universe on a large scale which impact these types of questions.

## 3.1 The Universe is Big, Really Big

If you are able to get away from the ubiquitous street-lighting, on a clear night it seems as though we can see countless stars. In reality, however, we can see only about 2,000. If we were to make a model of our whole Milky Way galaxy 3 metres across, almost all the stars we could see with our naked eyes on a clear, dark night would exist within a little bubble a few centimetres across, centred on our Solar System. All the other stars in our Galaxy lie beyond. In fact, the Milky Way consists of some 100 billion stars, of different sizes and different ages.

It is sometimes difficult to imagine just how large the Universe is. Douglas Adams started *The Hitchhiker's Guide to the Galaxy* as follows:

*Space is big. Really big. You just won't believe how vastly mindboggingly big it is. I mean you may think it is a long way down the road to the chemist, but that's just peanuts to space. (Adams, 1985: 39)*

As we have seen already, the vastness of space is a real problem for SETI. The hitchhiker wanting to find a new world is faced with problems of where to start, how long it is going to take to travel or communicate, or whether there may be inhabited worlds out there that you may never find. It is probably the easiest option for the aliens to come to you, even if they are about to demolish the Earth to make way for a bypass!

To acquire a sense of this, let us take a peanut to begin to imagine our galactic neighbourhood. If you imagine the Sun to be the size of a peanut located in London, then the Earth would be a speck of dust about half a metre away. It takes light 8⅓ minutes to travel to the Earth from the Sun. The Sun is orbited by eight planets with more than sixty moons, and a great number of asteroids and comets. However, even getting to the edge of our Solar System is only the beginning of any cosmic journey some 20 metres from our peanut. If we were to ask on our peanut scale where would we place the nearest star to our Sun placed in London, the answer would be another peanut in Sheffield. Space is an extremely empty frontier.

In order to talk of what is beyond the Solar System without having this book full of pages of zeros after each number, astronomers speak of distances in terms of light-years. This is the distance travelled by light, at its constant speed of approximately 300 million metres per second, over the time of one year. Using these units the distance to the nearest star system, α Centauri, is about 4 light-years. α Centauri and our Sun are amongst the stars that make up the Milky Way galaxy. This consists of a thin disc of stars distributed in a spiral pattern with a large concentration of mass in the galactic centre. We are located about two thirds of the distance from the centre in the disc, and the total diameter of the Milky Way is 100,000 light-years.

The galaxy nearest to us, at a distance of 160,000 light years, is the Large Magellanic Cloud, a tenth the size of the Milky Way. Galaxies come in all shapes and sizes. The Large Magellanic Cloud has no discernible pattern and is classed as an irregular galaxy. Some of them, such as M87, are huge elliptical galaxies, while others, such as Leo I, are called dwarf spheroidals, for obvious reasons. Some seem to be bright and young, others have very active sources of radiation at their centres, and some are in the process of being ripped apart by their neighbours.

Galaxies themselves group together in many ways. The Milky Way is part of some thirty-four other galaxies which make up the Local Group a few million light-years across, and this Local Group is on the edge of the Virgo Cluster of several hundred galaxies. The clusters and groups of galaxies are themselves arranged into larger combinations. Sky surveys and mappings of the various wavelength bands of electromagnetic radiation show clusters of galaxies and superclusters that are separated by immense voids. Thus the Universe appears as a collection of giant bubble-like voids separated by sheets and filaments of galaxies, with the superclusters appearing as occasional relatively dense nodes. The Milky Way itself is one of at least 100 billion galaxies in the observable Universe.

Recently, astronomers working with the Hubble Space Telescope assembled a new, improved portrait of the deepest-ever view of the Universe which we have. The eXtreme Deep Field, or XDF, comes from combining ten years of Hubble Space Telescope images of a patch of sky at the centre of the original Hubble Ultra Deep Field. The Hubble Ultra Deep Field is an image of a small area of space in the constellation Fornax, created using Hubble Space Telescope data from 2003 and 2004. The XDF contains about 5,500 galaxies even within its smaller field of view. The faintest galaxies are one ten-billionth the brightness of what the human eye can see.

Even in this small patch of sky can be seen something of the diversity and sheer number of galaxies. You also see back in time, as you see these galaxies as they were when the light left them on its journey to the recording instruments of the Hubble Space Telescope. The Universe is 13.7 billion years old, and the XDF includes galaxies from which the light has taken 13.2 billion years to reach us. That is, we are seeing them as they were within 500 million years after the Big Bang (Bouwens *et al*., 2011, Zheng *et al*., 2012).

The past decades have been a golden period for observing the Universe. The vastness of the Universe has been revealed by science in ways undreamed of by those who simply gazed at the sky. This has had a major effect on SETI. Just as Huygens and Bentley were encouraged to speculate on other worlds in response to the vastness of the Universe, so too it seems with our own generation.

Yet it is not only observations that have pointed to the possible plurality of inhabited worlds. Theoretical understanding of the Universe has also pushed us further. First, we need to note that the discussion up to this point has concerned the observable Universe—that is, the galaxies that we can, in principle, observe from Earth in the present day. This is because light from those objects has had time to reach the Earth since the beginning of

the Universe, 13.7 billion years ago. The importance of this is that some parts of the Universe may lie outside the observable Universe. In the future, some regions that lie outside the observable Universe will become part of it, as the light from these regions will have had more time to travel. However, owing to the fact that the Universe is expanding and indeed is accelerating in its expansion due to dark energy (Riess *et al*., 1998; Perlmutter *et al*., 1999), this leads to a 'future visibility limit' beyond which galaxies will never enter our observable Universe. If this is the case, then there may be ETI in galaxies outside of the observable Universe, and we will never know and never can know that they are there.

Wesson suggests that if intelligent life is sparse in the Universe, it might well lie beyond the observable Universe (Wesson, 1990). In fact, if it takes a civilization 4 billion years to evolve, as we have, the region that can contact us shrinks to 9.7 billion light-years. Reviewing the high odds against evolution of intelligent life, Wesson concludes that we are alone in the observable Universe. Extraterrestrial life may exist in the region we cannot see, but cannot be contacted.

Second, we remain uncertain as to the extent of the Universe beyond the observable Universe. In 1980, Alan Guth proposed a model called 'inflation'—a process which took place in the early Universe. The model postulated an early rapid (exponential) expansion, when the Universe was very young indeed—between $10^{-35}$ and $10^{-33}$ seconds. This was due to a phase change leading to the introduction of various particles into the Universe with the effect of antigravity. Guth discovered this while examining how the fundamental forces could be unified into a single force. It is thought that at high energies in the early Universe the forces are unified, but as the Universe cools, one of the forces (the strong force which is responsible for the structure of the nuclei of atoms) becomes distinct from the others. This has the effect of a phase change. This releases energy into the Universe, in a similar way to the phase change of steam into water releases energy in scalding. As a result of this the Universe expands from a region of space smaller than a proton to a volume about the size of a grapefruit, at which point the Hubble expansion takes over (Guth, 1997). Such models have the consequence that the Universe's size at present could be $10^{23}$ times larger than the observable Universe. In fact, in some models the Universe could be infinite. Again from this point of view, it increases the likelihood of other life but raises problems of how we would encounter it.

Third, it may be that our Universe is only one of many universes. Theories of the multiverse have become very popular in recent years, stimulated by some formulations of inflation or M-theory, which attempts to unite

gravity and quantum theory. Multiverses come in different models, where the laws of physics could be the same or could be different between each universe and the next (Tegmark, 2003). While there have been strong criticisms of whether we would ever be able to provide empirical evidence that other universes existed and therefore the suggestion more concerns metaphysics than physics (Holder, 2004; Ellis, 2011), there are those who see the possibility of multiverses as a dimension of SETI. In a speculative piece, Jenkins and Perez ask whether life exists in other universes outside our own (Jenkins and Perez, 2010). Imagining universes with different physical constants might allow, at least hypothetically, for the existence of life.

The views from observations and theoretical speculation do make us feel small. It parallels the Copernican revolution which opened up the space to speculate about other life-forms. But there may be one difference. For a long time it was difficult to obtain direct proof of the Copernican model. Galileo was able to provide considerable evidence both direct and indirect from within the Solar System, but the true test would have to wait until 1838 when F. W. Bessel demonstrated the parallax of stars. The difference with multiple universes is that it may be speculation which can never be empirically tested.

## 3.2 The Goldilocks Enigma

There may be a lot of stars in many universes, but on the other side of the argument in favour of the success of SETI is our growing understanding that certain things have to be just so to make possible the development of intelligent life (Hogan, 2000). Paul Davies calls it the 'Goldilocks enigma' (Davies, 2006).

A constant reminder of this is seen in our own Solar System. The Earth, Mars, and Venus are all made of similar materials. Yet even if primitive life did begin on Mars it did not develop into little green men and women: in fact, it did not develop even from the most primitive form. Mars is too small a planet to sustain life and indeed an atmosphere. Its surface temperatures of between –125° to 20° C coupled with the atmospheric pressure means that liquid water does not exist on the surface, though water still exists in limited quantities as ice. The thin atmosphere leads to severe fluctuations in temperature, and also lacks sufficient ozone to provide a shield from ultraviolet light (Goldsmith and Owen, 1992: 304–5).

Venus is our next-door neighbour, at its closest only 40 million km away. Ancient cultures associated Venus with beauty, and there are stories

that the founder of scientology, L. Ron Hubbard, claimed to have visited there. Venus features in a great deal of science fiction. Shrouded in clouds it was difficult to see what it was like on the surface, and this encouraged the belief that it might have inhabitants. The trouble is, however, that such inhabitants would feel like they were living in hell. The planet is less dense than the Earth, with a smaller core which could be entirely liquid. It lacks a driving force for a magnetic field, leaving the surface exposed to the solar wind which rapidly vapourises water leading to an extreme greenhouse effect. Far from a beautiful place, Venus is so hot that lead would melt, the atmospheric pressure is 90 times that of the Earth, and it has white clouds of sulphuric acid. These conditions, of course, make the development of even primitive life extremely unlikely.

Looking elsewhere in the Solar System does not contradict such a pessimistic view. Take, for example, Jupiter. At 764 million kilometres from the Sun, it is more massive than all the other planets put together. In fact some 13,000 Earths could fit inside it. It drags around a multitude of moons, two of which are larger than our Moon. It is, like Saturn, Uranus, and Neptune, a gas giant. The Galileo probe approached to only 160 kilometres before being crushed by the pressure of gases. Deep within there could be a solid surface of hydrogen, but no-one knows. Some suggestions of life have been made, but it would have to be of a quite exotic form. Life able to float in the atmosphere seems to be the only possibility. More likely for life would be the moons, although the largest moon, Io, has a dozen active volcanoes and is covered with thick sulphurous clouds. Another moon, Europa, has no atmosphere and is icy and very smooth, and there have been some recent claims that its icy surface could be floating on slush or even water. We will return to this later in the book.

Nevertheless, Jupiter does highlight the odd circumstances which allow us to exist. In 1994 comet Shoemaker–Levy 9 collided with Jupiter in spectacular fashion (Barnes-Svarney, 1996). The important point to note is that if Jupiter had not been there, then there would have been a chance that the comet could have collided with one of the inner planets.

The Oort Cloud is a cloud of perhaps millions and millions of comets which lie orbiting on the edge of the Solar System. Some of these comets are occasionally dragged out of this cloud by passing stars and vast molecular clouds of hydrogen and into orbits which take them into the inner Solar System (Bailey *et al.*, 1987; Wolfendale and Wilkinson, 1989). This is somewhat serious for us, especially if the orbit of the Earth intersects the orbit of the comet. Such a comet impact was a possible cause of the extinction of the dinosaurs some 65 million years ago (Billoski, 1987). In

addition, a number of asteroids orbit within the Solar System, potentially causing additional catastrophes for the Earth. The impact of an asteroid only 100 metres wide would lead to tidal waves or an explosion capable of destroying a large city, depending on whether it impacted on sea or on land. Smaller asteroids not leading to extinction events may be expected every 300 thousand years, while larger ones capable of mass extinction might be expected every 100 million years.

Without Jupiter, the situation would be far worse, as the planet considerably reduces the number of potentially lethal comets and asteroids (Wetherill, 1991). George Wetherill states:

> *Without a Jupiter-sized world in our planetary system, collisions with large comets and other dangerous objects like massive asteroids might occur with terrible frequency, not once every 50 million years as they do at present, but at least once every 100,000 years. This would make it extremely difficult for a civilization to evolve, and the simple answer is that there might not be one. (Wetherill, 1996)*

This is yet another reminder of the very special circumstances needed for intelligent life to evolve, not least in that the rest of the planetary system needs to be configured in a particular way.

The presence of a Jupiter-like planet and the size of the orbit of the Earth which maintains a temperature for liquid water are just two examples of a broader class of circumstances and laws which are just right for the development of intelligent life. These have come to be called anthropic balances; that is, if they were different then life on Earth would not exist.

This has often been used to give the impression that the Universe is set up for life on Earth. In 1904 the evolutionary biologist Alfred Russel Wallace noted:

> *Such a vast and complex Universe as that which we know exists around us, may have been absolutely required… in order to produce a world that should be precisely adapted in every detail for the orderly development of life culminating in man. (Wallace, 1904: 256–7)*

Later in the century, Robert Dicke considered the age of the Universe and concluded that the age is not random but conditioned by the fact that the Universe has to be old enough to allow physical and biological processes to produce life. Without such time and processes, it 'would preclude the existence of man to consider the problem' (Dicke, 1957).

Over the past couple of decades such balances have been discovered at a much deeper level in the laws of physics themselves. This is not simply

about life on Earth but life as we know it. For example, the production of carbon exhibits such a feature (Oberhummer *et al*., 2000). Carbon is formed by the combination of either three helium nuclei or by the nuclei of helium and beryllium. But for carbon to be formed, the internal energy levels of the nuclei have to be just right. There has to be what is called 'resonance'. If this resonant energy level were only 0.5% different, no carbon would be formed. In addition, the resonance which would convert all the carbon into oxygen is just 1% too high. If it were 1% lower, once again there would be no carbon. Sir Fred Hoyle, who discovered such an arrangement, later said: 'Nothing has shaken my atheism as much as this discovery.' There seems to be fine-tuning here in the production of carbon, and of course that is very important in providing the basis for carbon-based life.

In 1973, at a symposium in honour of the 500th anniversary of the birth of Copernicus, Brandon Carter formulated the anthropic principle, reflecting on the extraordinary nature of the laws and circumstances which produce life. Carter suggested that while human beings are not central to the Universe, our existence is 'inevitably privileged to some extent' (Carter, 1974). This is interesting, not least from the way that in the previous chapter we outlined the great influence of the Copernican revolution in thinking about the plurality of worlds.

While Carter defined both weak and strong versions of the anthropic principle, these definitions were pushed forward by Barrow and Tipler. They defined the weak anthropic principle as follows:

> *Weak anthropic principle (WAP): The observed values of all physical and cosmological quantities are not equally probable, but they take on values restricted by the requirement that there exist sites where carbon-based life can evolve and by the requirements that the Universe be old enough for it to have already done so. (Barrow and Tipler, 1986: 16)*

In this form, the anthropic principal simply outlines a selection effect. The values are what they are because we are here to observe them. However, the strong anthropic principle states as follows:

> *Strong anthropic principle (SAP): The Universe must have those properties which allow life to develop within it at some stage in its history. (Barrow and Tipler, 1986: 21)*

Wheeler goes further, using the importance of human observers in solving the measurement problem in quantum mechanics to speak of a *participatory anthropic principle*; that is, that observers are necessary to bring the Universe into being (Wheeler *et al*., 1988).

Discussion continues as to the significance of the anthropic principle. Bostrom argues that it simply means that the data we collect about the Universe are filtered not only by the limitations of our instruments, but also by the precondition that somebody be there to 'have' the data yielded by the instruments (and to build the instruments in the first place). This precondition causes observation selection effects; that is, biases in our data that may call into question how we interpret evidence that the Universe is fine-tuned at all (Bostrom, 2002).

Others want to go further. In his book *Just Six Numbers* Martin Rees notes the extraordinary fine tuning of six numbers fundamental to the Universe (Rees, 2000). These numbers represent the ratio of the electric force to the gravitational force; how firmly atomic nuclei bind together; the amount of material in the Universe; the cosmological constant; the ratio of energy needed to disperse an object compared to its total rest mass energy; and the number of spatial dimensions in the Universe. If any of these numbers were only slightly different to what they are, we would not be here.

Rees then sees three possible explanations. The first is simply to say that this is just the way things are. He finds this unsatisfying because the fine-tuning of these numbers is so remarkable that it poses 'why' questions. The second is to see this fine-tuning as evidence of a Creator God. However, his own answer is that the anthropic principle selects this Universe out of many. That is, we see this fine-tuning because we are here. In other universes where these numbers were different there would be no-one there to see them.

Rees is correct in seeing that there is an alternative explanation to arguing that the fine-tuning of the Universe is evidence for the existence of God. The alternative is that the anthropic principle selects our Universe from many universes. This is an important reminder that anthropic balances are not the basis for resurrecting the design argument of the eighteenth century and trying to prove God. Yet the status of existence of many universes means that Rees' alternative explanation remains more philosophical than scientific at this time.

Anthropic balances have reshaped the landscape of the Copernican revolution and its influence on SETI. Anthropic balances on the Earth suggest that the development of intelligent life could be very rare indeed. More fundamentally, might the anthropic principle be telling us that in some way the existence of the Universe is linked to our existence? Paul Davies has been very impressed with the extraordinary nature of anthropic balances, and further our ability to comprehend the mathematics of the Universe. He writes:

> *Through science we human beings are able to grasp at least some of nature's secrets…Why should this be, just why Homo Sapiens should carry the spark of rationality that provides the key to the Universe is a deep enigma. We who are children of the Universe—animated stardust—can nevertheless reflect on the nature of the same Universe, even to the extent of glimpsing the rules on which it runs…What is Man that we may be party to such privilege? I cannot believe that our existence in this Universe is a mere quirk of fate, an accident of fate, an incidental blip in the great cosmic drama. Our involvement is just too intimate. The physical species Homo may count for nothing, but the existence of mind in some organism on some planet in the Universe is surely a fact of fundamental significance…This can be no trivial detail, no minor byproduct of mindless purposeless forces. We are truly meant to be here. (Davies, 1992: 173)*

Anthropic balances can be interpreted in different ways, but they should not be dismissed. They are a significant factor of the way the world is, and we need to note that they have fed into a number of ways to science, religion, and SETI.

## 3.3 Drake's Equation: Agenda or Calculation?

Of all of the pioneers of SETI, Frank Drake has perhaps done more than anyone. As well as mounting the first observational attempt at detecting extraterrestrial communications, in 1960, a year later, at the National Radio Astronomy Observatory in Green Bank, West Virginia, Drake developed a simple equation to estimate the number $N$ of intelligent civilizations in our Galaxy.

Its value is that it identifies specific factors that we need to know about to discover ETI. Although there is no generally accepted solution to this equation, it is a tool used by the scientific community to examine these factors.

The equation itself came from Drake's thinking about an agenda for a meeting he had been asked to convene by the National Academy of Sciences on detecting extraterrestrial intelligence. He began to write down all the factors that would predict how difficult it would be to detect ETI. He realized that multiplying them all together he would obtain a number, $N$—the number of detectable civilizations in our Galaxy.

Of course, this number refers to those civilizations which might be seen by observational searches rather than just life in general.

The equation is usually written:

$$N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

where

- $N$ is the number of civilizations in the Milky Way whose electromagnetic emissions are detectable,
- $R^*$ is the rate of formation of stars per year suitable for the development of intelligent life,
- $f_p$ is the fraction of those stars with planetary systems,
- $n_e$ is the number of planets, per solar system, with an environment suitable for life,
- $f_l$ is the fraction of suitable planets on which life actually appears,
- $f_i$ is the fraction of life bearing planets on which intelligent life emerges,
- $f_c$ is the fraction of civilizations that develop a technology that releases detectable signs of their existence into space, and
- $L$ is the length of time such civilizations release detectable signals into space.

This is a very difficult equation to use, due to the factors which enter into it. $R^*$ can be established observationally, and as we will see in the next chapter we may be able to estimate observationally $f_p$ and $n_e$. The other factors are beyond current observations, and indeed for all of them we currently have only one case; that is, the Earth.

It is therefore not surprising that different people derive wildly different results out of such an equation. At Drake's meeting, the product of the first six factors was optimistically assumed to be 1, reducing the equation to $N = L$. But even then we have to estimate the lifetime of an advanced civilization. Drake estimated $L$ to be 1,000–100 million years, and therefore there were probably between 1,000 and 100 million civilizations in the Galaxy. A few years later, Shklovskii and Sagan inserted values of $R^* = 10$ stars/year, $f_p = n_e = f_l = 1$, $f_i = f_c = 0.1$ and $L = 10$ million years, thus giving $N$ as about 1 million advanced civilizations in our Galaxy (Shklovskii and Sagan, 1966: 410–3). Others put in other numbers and produce one advanced civilization in the Galaxy; that is, us!

Far more confident is Amir Aczel, who published *Probability 1: The Book that Proves There is Life in Outer Space* (Aczel, 1998). Aczel's argument is simply that Drake's equation must be equal to or greater than 1, on the basis that all it takes is one factor in the equation to possess an extremely

large value for the outcome to be one or greater. For Aczel this is the number of planets that may exist in the observable Universe and beyond, especially taking multiverses into account. Yet of course it takes only one value to be very small or zero to cancel this out. And invoking multiverses is a little suspect, as the Drake equation is meant to help us to search for extraterrestrial intelligence, which would be impossible if it were in another universe.

While solving the equation may be impossible, it does direct us to the type of questions that we need to address observationally and theoretically. It also points out that in order to know that ETI is there we need to assume the following:

- Such life develops a level of intelligence which allows it to transmit messages through space.
- Such life would want to communicate, or in other words they would be as interested in finding us as we are in finding them.
- Such life would survive long enough to enable such communication.

The Drake equation also reminds us that even at its higher estimate of the numbers of civilizations in the Galaxy, the average distance between stars with such civilizations would be at least hundreds of light-years. Without *Star Trek*'s warp drive, one of the problems is going to be that of making contact over such vast distances.

## 3.4 ET's Long-Distance Phone Call Home

In some sense, space is not very far away. Felix Baumgartner can jump from a balloon capsule 39 kilometres above the ground and receive headlines of 'parachuting from space', while more than 500 space tourists have already booked their places with Virgin Galactic. Yet in another sense the vast distances of space provide SETI with obvious problems of how communication might be achieved.

As we have seen, our nearest neighbour in terms of star systems is α Centauri. It is a mere 4.3 light-years away, compared to the size of our Milky Way, which is 100,000 light-years across. If we had sent Voyager 1 to α Centauri it would take 72,000 years to travel there, for it is moving at $^{1}/_{18,000}$ the speed of light. With current rocket technology that journey time could be reduced by a factor of four, but that is still a journey that takes longer than the history of human beings. Could future technology help us? Back in 1968, Dyson suggested a spacecraft powered by the shock-waves from a series of nuclear explosions. At 3% of the speed of light it would

have reached α Centauri in 130 years. The only problem is that it would require hundreds of thousands of bombs and cost 10% of the US GDP! (Dyson, 1968).

Might future technology allow us to travel faster than the speed of light? The difficulty with faster-than-light travel is Einstein's theory of Special Relativity. As a spaceship accelerates towards the speed of light it actually increases in mass. We do not see this effect in everyday life because the speeds that we experience are very much smaller than the speed of light. At these speeds the increase in mass is imperceptibly small. However, as the spaceship approaches the speed of light the increase in mass means that more energy is required to increase its speed. At the speed of light the amount of energy needed to accelerate the spaceship becomes infinite, and so this forms an upper limit to how quickly the spaceship can travel between the stars. Therefore, the journey to α Centauri would have a lower limit of more than four years.

Of course, technical and economic limitations mean that the ship would never be travelling at more than a fraction of the speed of light, and so the travel time would be much longer. Now, this is the travel time as seen from the Earth. One of the other curious things about Einstein's theory is that time runs more slowly if you are travelling very close to the speed of light. Therefore, if you were to be on board a spaceship which accelerated to close to the speed of light, then your measurement of time would be very different from that measured by Mission Control on Earth. It would appear to you that the journey has taken much less time than it appeared to do from Mission Control. Does this help with the long journeys? It is only when you approach close to the speed of light that the time dilation effect really matters. If you were able to accelerate a spaceship to one tenth the speed of light, then the journey to α Centauri would take 40 years as measured by Mission Control, but the astronauts would measure a time only 73 days shorter. Even at half of the speed of light, which is extremely optimistic, it would take 8 years to travel to the nearest star, the astronauts 'saving' 1 year and 26 days.

The speed of light is an unfortunate barrier to realistic space travel between the stars. As we have seen, this has encouraged science fiction writers as well as scientists to dream of other mechanisms of travel, whether it be Sagan's wormholes or *Star Trek*'s warp drive. These suggestions, similar to Dyson's, may be theoretically possible but impractical in terms of the engineering and the cost (Alcubierre, 1994, Kaku, 2009).

Just as travel is constrained by the speed of light and the vast distances of space, communication is also constrained. Messages would take millions

of years to exchange unless some form of faster-than-light communication were found. Any residents of α Centauri would be currently enjoying radio and TV coverage of the US Presidential election between Obama and McCain, for it would take more than four years for these signals to reach them from the Earth. But any civilization in our close neighbour galaxy in Andromeda which beamed a radio message towards the Milky Way saying 'Hello, is there anyone there' would have to wait a couple of million years for the message to be received, and then a couple of million years for a response of 'Yes, we are here, how are you?' to make its way back. That does not present the prospect of an exciting conversation.

There is a further problem. In a paper published in 1992, George Lake quotes a private communication from Carl Sagan stating that the absence of detections of extraterrestrial intelligence from the $10^{20}$ extragalactic stars that have been surveyed to date is already a remarkable result (Lake, 1992). Lake goes on to argue that this is not due to the lack of extraterrestrial intelligence, but to the fact that the time-scale for the evolution of an advanced civilization is short compared to the time it takes for any message to cross the vast distances between the galaxies. We are effectively surveying many galaxies at a time before civilizations have evolved.

Such problems in communication have led to some speculation about whether there may be any other mechanisms that could go beyond the speed of light. Once again, science fiction writers and scientists have shared a similar space.

We do know of at least one phenomenon which seems to communicate information faster than the speed of light. In 1935, Einstein, with collaborators Boris Podolsky and Nathan Rosen, highlighted what they believed was an unacceptable consequence of quantum theory. In what is now called the EPR experiment or paradox, they pointed out that two quantum particles such as electrons, once they have interacted with each other, retain the ability to influence each other even though they are separated by extremely large distances. Imagine two electrons which interact with each other. If I examine one of them, this has an instantaneous effect on the other even if it is at a great distance, such as on the other side of the galaxy. Einstein felt that this showed that quantum theory was incomplete. Although this seems to go against everything we assume about the world, observations have confirmed that this really happens. Einstein was wrong, and quantum theory is right. Now, does this suggest that faster-than-light propagation of information is a possibility? Certainly a message cannot be sent from one electron to the other at the speed of light, as the change is instantaneous. What the EPR experiment is demonstrating is that at the

quantum level—that is, at the level of the particles which make up atoms—there is, in John Polkinghorne's phrase, 'togetherness in separation' (Polkinghorne, 1986). However, detailed work in this area shows, for a number of reasons, that it does not lead to 'spooky communication at a distance' (Ghirardi, 1988).

Another theoretically possible way of sending information faster than the speed of light is by particles called 'tachyons'. We need to say quickly that no-one has ever seen a tachyon, and their existence remains controversial, though that has not prevented speculation about their implications for travel and communication (Blaha, 2011). However, within Einstein's theory they can exist. The theory of Special Relativity says that you cannot accelerate a particle from a speed below the speed of light to a speed above it. But if you create a particle already travelling faster than the speed of light then the theory does not rule out such faster-than-light travel. This could be used for communication as long as you were able to create such tachyon particles at one end and then find a way of detecting them at the other end.

Often when science presents a problem, there is a tendency to try to use something beyond science to provide a solution. It is interesting that in the 'spirituality' around belief in aliens there is a tendency to look to communication through telepathy or spiritual experience. For example, 'Calling Occupants of Interplanetary Craft (The Recognized Anthem of World Contact Day)' was a song by the band Klaatu, originally released in 1976 and then later covered by The Carpenters. John Woloschuk, one of the song's composers, explained that the idea came from an experiment in which people were encouraged to send out, at a predetermined date and time, a telepathic message to aliens.

Of course, one would only be tempted to make a big investment in communication if there was the belief that there was something out there with which to communicate. The Universe might be a big place, but we need to be confident that there is at least a chance that the Goldilocks enigma does not mean that we are alone.

If we are to depart on a space flight for many years to α Centauri, then we need to have some hope that we shall find something interesting when we arrive. In fact, we have received such encouragement with the news that α Centauri contains at least one planet (Dumusque *et al*., 2012). This is one planet discovery among many which for the past two decades has changed completely our view of SETI.

# 4
# The Daily Planet

If the belief in ETI was undermined at the end of the nineteenth century by difficulties in thinking about how planets form around stars, then in contrast at the end of the twentieth century the discovery of planets around stars other than the Sun has been one of the most important factors in reigniting SETI and the belief that the search will be successful. Before the 1990s the only planets we had seen were the planets of our own Solar System orbiting our Sun. In 1995 there was the first confirmed example of an extrasolar planet around a normal star. Today, an app on my smartphone updates daily the new discoveries of planets. At the time of writing the number is 828, with the latest discovery, HD 4732b, being a gas giant. It is twice the size of Jupiter and takes 360 days to orbit its star. Such a discovery, if announced twenty years ago, would have been hailed as incredible. Now, it is a rather unremarkable discovery of a rather unremarkable planet. Even the 828 seem to be just a small fraction of future discoveries.

Yet this excitement should not be taken too far. Before rushing to discussions of the likelihood of little green men and women throughout the Galaxy, and its religious consequences, we must look at the variety of methods in this process of finding planets and also what kind of planets might be able to sustain the evolution of intelligent life. As with all science, there are insights and uncertainties.

## 4.1 Finding another Earth?

In sending out an email concerning some study leave involved in the writing of this book, my long-suffering PA made a rare mistake. She stated that I would be away for a few months writing about the search for terrestrial intelligence! However much we may doubt at times the intelligence of our fellow humans and indeed at times ourselves, we do have a starting point in

the search for extraterrestrial intelligence. Intelligent life has developed on planet Earth.

There are a number of things which are obvious in making this possible. There is the presence of liquid water and an atmosphere which contains almost 20% oxygen. Indeed, to sustain the kind of complex intelligent life we observe, rather than just microbial life, we need the following (Gilmour, 2011: 44):

- Oceans and dry land.
- Moderately high oxygen and low carbon dioxide abundance.
- An ozone layer to shield the surface from ultraviolet radiation.
- Long term climate stability.

These are then dependent on such things as plate tectonics, the size of the Sun, the orbit of the Earth, comet and asteroid impact rate, the presence of a large natural satellite, and a long-term planetary heat source.

The Earth exists within a circumstellar habitable zone (HZ) which is sometimes defined as the range of distances from a star where liquid water can exist on a planetary surface. However, stars vary in their energy output over their lifetime, and we also have to factor in the way that a planet's atmosphere both radiates heat energy away and locks energy in through greenhouse gases. Casting *et al*. have calculated that for our own Solar System the so-called continuous HZ (where liquid water is present on the surface of a planet for the majority of the life of the Sun) is 0.95–1.15 of the mean Earth–Sun distance (Kasting *et al*., 1993).

So, we begin to see that we need to find a rocky planet, at a certain distance from its star and with a certain type of atmosphere if we are to start finding life anything like ours. There are, however, other considerations. The larger a star, the shorter its lifetime; so stars have to be less than about 1.5 times the mass of the Sun to be sufficiently stable for the development of complex life. Then, more than 50% of stars in our Galaxy are in binary or multiple systems, which makes the HZ much more difficult, not least because one of the stars could use up its fuel quicker and then undergo a supernova explosion, becoming a neutron star or a black hole. The supernova explosion would send shock waves and intense electromagnetic radiation through the planetary system. If that were not sufficient to wipe out any living organisms, then the radiation from the remnant neutron star or black hole would finish off the job.

It is clear that there are certain parts of our Galaxy itself which are less amenable to habitable zones. For example, the centre of our Galaxy has large gravitational forces and fluxes of electromagnetic radiation associated

with the large number of stars and the super-massive black hole at the centre of the Galaxy. Not all stars, even if they had planetary systems, could support life.

As we saw in the previous chapter, one of the factors that had a negative impact on the belief in ETI at the end of the nineteenth century was problems with the nebular hypothesis to explain the birth of planets. Throughout the twentieth century, alternative theories were proposed, from tidal models to capture models (Woolfson, 2007). Yet from the 1970s the nebular hypothesis returned through the work of Safronov and Wetherill (Safronov, 1972; Wetherill, 1991). This new version of planetary formation—the Solar Nebular Disk Model (SNDM)—is now widely accepted, though it is not without problems. It is clear that stars form out of giant clouds of molecular hydrogen gas throughout the galaxy (Rana and Wilkinson, 1986). In the case of our Sun, about 4,500 million years ago, a vast cloud of gas, trillions of kilometres in diameter, began to collapse under gravity. This cloud was part of a giant complex of clouds composed mainly of molecular hydrogen. Also in the cloud were relatively small quantities of many other elements such as carbon, oxygen, and iron. These elements had been produced in the death throes of a previous generation of stars and had been spewed out into space.

The initial collapse of this 'protostellar nebula' takes about 100,000 years. Gas in the central part of the nebula, with relatively low angular momentum, undergoes fast compression and forms a hot core, the seed of what will become a star. Conservation of angular momentum means that the rest of the gas forms a disc, which then is slowly added to the core. The core increases in mass until it becomes a young hot protostar. If there is enough mass of gas, the core, as it is compressed, heats up, until at a temperature of 30 million K, hydrogen is fused into helium and a star is born.

The remaining disc can now give rise to planets. Indeed, some of these protoplanetary discs can be seen around young stars (Klahr and Brandner, 2006). High temperatures close to the young star means that most of the volatile materials such as water evaporate, leaving heavier elements such as iron to form dust particles, aggregating into planetesimals which could be larger than 1 kilometre, which in turn are the building blocks of planets. The formation of these planetesimals is not simple, and complex modelling has to take into account gravitational instabilities in the disc, turbulence, flows inwards and outwards in relation to the star, and the different elements involved. After this process there follows various accretion processes where larger bodies are built up. First, runaway accretion begins leading to the preferential growth of larger bodies at the expense of smaller ones. This is

followed by oligarchic accretion where only the largest bodies grow, until there are no longer planetesimals in the disc around them. There are some mergers of the larger bodies.

Such a process works well to explain the formation of rocky inner planets. More difficult is understanding how the gas giants in a planetary system form. Indeed, these planets must form relatively quickly, before the gas in the protoplanetary disc is dissipated. The majority view is that this happens by core accretion—a two-stage process. The first stage is very like the process described above. Large solid cores of approximately ten Earth masses form from planetesimals in the outer regions of the disc. The second stage is the accretion of gas from the protoplanetary disc. Growth ceases when the supply of gas is terminated, either because the planet opens a gap in the disc or because the disc gas dissipates. There remains an alternative theory: gravitational disc instability, which also remains under study. Instability could lead to fragmentation of the disc into objects which have masses comparable to giant planets. This is much more rapid mechanism (Boss, 2000).

Such processes were going on for some 4.5 billion years in our own case. They led to a rocky planet, third from the star, and it had a mixture of special circumstances. It held a stable orbit at a distance from the star where, due to its surface temperature, water existed in liquid form. It was of sufficient size that it was able to retain an atmosphere that a smaller body like its own Moon was unable to do, and it was able to sustain a reasonable level of geological and meteorological activity which made the existence of life possible.

The question, therefore, is how widespread is this kind of possibility? While theoretical studies can make some progress, during the last two decades the field has been transformed by observational techniques that give the promise of seeing other Earth-like planets.

## 4.2 Wobbling Stars

The main difficulty in seeing other planets outside our own Solar System is easy to understand. Stars emit a thousand million times more light than even the largest planets such as Jupiter. It is like picking out a light bulb beside a searchlight. So astronomy has had to be creative and subtle.

In 1992 the first planet around a special type of stellar remnant—namely, pulsars—was found. In the early 1990s, Alexander Wolszczan provided evidence of three planets orbiting the pulsar PSR 1257+12 (Wolszczan and Frail, 1992). The pulsar is only about 10 km across, but

contains more matter than our Sun. It spins rapidly and emits a beam of radio waves rather like a lighthouse. The three planets cannot be seen directly, but they change the period of the radio pulses as they orbit around it. The pulsar itself formed as the leftover remnant of a star which underwent a massive supernova explosion. This explosion would have destroyed any planetary system the star had at the time, so the planets which are now seen are thought to have been formed from the debris of a companion star also disrupted by the pulsar. It is a strange planetary system. It must be stressed that we are not talking about the possibility of life here. Indeed, any life on the planets would find itself, having survived a catastrophic explosion, now living beside a gigantic X-ray machine! What is important about this system is that it was the first confirmation of planets of any type outside our Solar System, and indicated that a different type of technique could be used.

This indirect technique attempted to look for the influence of planets on their parent stars. As a planet orbits around a star, the star should 'wobble' in its position due to the gravitational pull of the planet. Trying to detect this wobble in position against the background stars is theoretically possible, but is difficult to achieve with current technology. NASA's Space Interferometry Mission would have been able to see this movement of a star relative to more distant background stars, using two telescopes separated along a baseline acting as a single powerful instrument. However, this mission has been a victim of budget cuts and will not be developed.

Nevertheless, the wobble has another effect. This is an effect on the light emitted by the star, and it is this property which has led to success in detecting extrasolar planets. The technique is called Doppler spectroscopy, or the radial velocity method. The light from stars can be split into a spectrum of lines, and when an emitting star is moving, these lines are shifted across the spectrum compared to a stationary emitter. This Doppler shift is then used to measure the tug of planets on stars, as an unseen planet tugs the star back and forth. Lines in the star's spectrum shift slightly to the red end of the spectrum as the star moves away from the observer, and slightly to the blue as it moves toward the observer. This shift is periodic because of the planet's orbit. From the radial velocity (which is the component of velocity along the observer's line of sight) and the period, and combining this with knowledge of the mass of the star (calculated from the brightness of the star), the radius of the orbit of the planet and a limit on the minimum mass of the planet can be determined.

Using the radial velocity method, astronomers can only estimate a minimum mass for a planet, as the mass estimate also depends on the tilt of the

orbital plane relative to the line of sight, which is unknown. From a statistical point of view this minimum mass is, however, often close to the real mass of the planet. However, it is important to note that as this method does not involve direct observation of the planet there is no information on the planet's composition. Also, if a planet's orbit is tilted 90° to our line of sight, no Doppler shift will be seen in the star's spectrum, no matter how massive the planet.

As planets close to their stars complete a cycle around their stars more quickly, and because massive planets tug harder on their stars and cause the biggest Doppler shifts, this technique tended first to see planets which were massive and located close to their stars.

In October 1995, Michel Mayor and Didier Queloz of the Geneva Observatory detected a planet orbiting the star 51 Pegasi, which is 48 light years away in the constellation of Pegasus (Mayor and Queloz, 1995). They estimated that it was about half the size of Jupiter but closer to its star than Mercury is to the Sun. It takes four days to orbit the star, and could have a temperature of around 1,000 K. This was the first planet around a normal star, and added to the sense that planets were widespread in the Universe. Then, in December 1995, Geoffrey Marcy and Paul Butler of San Francisco State University discovered what they believed to be a planet around the star 70 Virginis, which is around 50 light years away, though once again it was six times the mass of Jupiter, with all the associated problems of sustaining life (Marcy and Butler, 1996).

Over the intervening years the method has been refined and has yielded hundreds of exoplanets, including a number of candidates that are much closer to the size, orbit, and temperature of the Earth. In 2011 a team led by Mayor announced a 'rich haul' of more than fifty new exoplanets, including sixteen super-Earths (planets with a mass between 1 and 10 times that of the Earth), one of which orbits at the edge of the habitable zone of its star. The group use the HARPS spectrograph on the 3.6-metre telescope at ESO's La Silla Observatory in Chile. Observing 376 Sun-like stars, they have estimated how likely it is that a star like the Sun is host to low-mass planets (as opposed to gaseous giants). They suggest that about 40% of such stars have at least one planet less massive than Saturn. The majority of exoplanets of Neptune mass or less appear to be in systems with multiple planets. They also looked for rocky planets that could support life, and discovered five new planets with masses less than five times that of Earth. One of the recently announced newly discovered planets, HD 85512b, is estimated to be only 3.6 times the mass of the Earth, and is located at the edge of the habitable zone. The increasing precision of the new HARPS

survey now allows the detection of planets of less than 2 Earth-masses. So far, HARPS has found two super-Earths that may lie within the habitable zone (Dumusque *et al*., 2011; Figueira *et al*., 2012; Pepe *et al*., 2011).

## 4.3 Dimming Stars

If you were observing our Solar System from far away, the movement of Jupiter across your line of sight to the Sun would dim the Sun by 1 part in 100. This would be independent of the distance to the planetary system, depending only on the different radius of the planet compared to the star. This transit method becomes a very powerful method for detecting extrasolar planets—not least in looking for planets further away than can be detected by the radial velocity method—and was first successfully used in 2003, in identifying a planet some 5,000 light-years away. Not only does it allow you to see planets, but also during an occultation the atmosphere of a planet will absorb some of the radiation emitted by its companion star. Absorption lines may thus be detectable, and indeed have led to the identification of carbon dioxide, methane, and water.

NASA's Kepler mission has been using this technique very successfully since its launch in March 2009.[1] It uses the transit method to search for planets around 150,000 stars, using a specialized 0.95-metre photometric telescope to measure small changes in brightness caused by these passing planets. But to observe Earth-like planets transiting stars similar to our Sun, Kepler needs to see a dip in the star's visible light by only 84 parts per million. The mission is designed specifically to discover hundreds of Earth-size and smaller planets in or near the habitable zone and determine the fraction of the hundreds of billions of stars in our Galaxy that might have such planets. Kepler's detectors therefore have to reliably measure changes of 0.01%. It is a remarkable instrument, and by October 2012 it had already discovered 77 confirmed planets and collected more than 2,300 planetary candidates.

The technique is extremely powerful for a number of reasons. First, it yields a great deal of information. Once a transiting planet is detected, its orbit can be calculated from the period and the mass of the star using Kepler's Third Law of planetary motion. The size of the planet is found from how much the brightness of the star drops, and the size of the star. Then, from the orbit of the planet and the temperature of its star, the tem-

[1] <http://www.nasa.gov/mission_pages/kepler/overview/index.html>

perature of the planet is indicated. We thus have information to determine whether the planet is in the habitable zone.

Second, the Kepler instrument has a very large field of view, 105 square degrees, which enables the mission to observe a very large number of stars. Since transits last only a fraction of a day, all the stars must be monitored continuously; that is, their brightness must be measured at least once every few hours. At least three transits are required to verify a signal as a planet. Thus Kepler will simultaneously monitor the brightness of more than 100,000 stars through to the end of its mission which has been extended to 2013 (Borucki *et al*., 2010). The Kepler science team uses ground-based telescopes and the Spitzer Space Telescope to review observations of planetary candidates found by the spacecraft. Computer programmes are then used to run simulations to help rule out other astrophysical phenomena masquerading as a planet.

The power of this technique has produced some stunning results. For example, it discovered three small planets orbiting the star KOI-961, all smaller than the Earth and the smallest being the size of Mars. Then, in December 2011, Kepler-22b became the mission's first confirmed planet in the habitable zone of a Sun-like star—a planet 2.4 times the size of Earth. At the same time, Kepler-20e and Kepler-20f became the first Earth-size planets orbiting a Sun-like star outside our Solar System. Kepler-20e is slightly smaller than Venus, measuring 0.87 times the radius of Earth. Kepler-20f is a little larger than Earth, measuring 1.03 times its radius. Both planets reside in a five-planet system called Kepler-20, approximately 1,000 light-years away in the constellation Lyra (Fressin *et al*., 2012). While Kepler-20e and Kepler-20f are Earth-size, they are too close to their parent star to have liquid water on the surface.

Another significant discovery was Kepler-16b, the first unambiguous detection of a circumbinary planet; that is, a planet orbiting two stars (Doyle *et al*., 2011). It was portrayed in the media as the *Star Wars*' planet Tatooine, having a double sunset, though rather than its being the hot desert home of Luke Skywalker it is a cold world about the size of Saturn and thought to be made up of about half rock and half gas. As a great number of stars exist in binary systems, this discovery signals that there may be more planets than we previously thought.

This was quickly followed by the announcement of the discovery of the first transiting circumbinary multi-planet system Kepler-47 (Orosz *et al*., 2012). This system consists of two planets orbiting a pair of stars. The discovery further shows that planetary systems can form and survive even in the bizarre environment around a binary star. Even more interesting is that

the outer planet, which is slightly larger than Uranus, orbits in the habitable zone.

It is worth noting that while the public announcement of such objects received great attention, each announcement is dependent on detailed work and a great deal of caution. Each of the objects has to be 'validated'. That is, it has to be ruled out that something other than the planet be responsible for the observed dips in brightness. Speaking of a recent planet discovery, Cochran commented:

> *[We are] confident that it is probably a planet… We are trying to prepare the astronomical community and the public for the concept of validation… Proving that such an object really is a planet is very difficult. When we find what looks like a habitable Earth, we will have to use a validation process, rather than a confirmation process. We are going to have to make statistical argument'. (Massey, 2011: 6.30)*

## 4.4 Brightening Stars

Einstein's theory of General Relativity predicts that the path of light can be bent by the presence of a gravitational field around a massive body such as a star or even a planet. This is called gravitational lensing. Astronomers looking for planets have used this principle in a technique called microlensing. This is where light from distant stars has a temporary brightening due to the presence of mass between the distant star and the observer.

In 2012 an international team, using the technique of gravitational microlensing, concluded that planets around stars are the rule rather than the exception (Cassan *et al*., 2012). Microlensing is not as sensitive as radial velocity or even transit methods in detecting potential planets that have to be massive or close to their star.

Microlensing can detect planets over a wide range of mass and those that lie much further from their stars. The gravitational field of their host stars, combined with that of the possible planets, acts like a lens, magnifying the light of a background star. If the star that acts as a lens has a planet in orbit around it, the planet can make a detectable contribution to the brightening effect on the background star. However, the right alignment of a background and lensing star, plus the planet, is necessary if microlensing is to be seen.

Six years' worth of microlensing data was used, yielding three exoplanets. This may not seem a lot, but the fact that planets and stars have to be in the right alignment means that either the astronomers were incredibly

lucky, or planets are so abundant in the Milky Way that it was almost inevitable. The conclusion was that one in six of the stars studied host a planet of mass similar to Jupiter's, half have Neptune-mass planets, and two thirds have super-Earths.

## 4.5 Young Planets and Hot Planets

While radial velocity, transit, and microlensing methods produce very fruitful results, there are other possibilities in searching for planets.

As we saw earlier, it seems likely that planets form around stars in dusty discs. The Subaru telescope has looked at a disc around HR4796A, a young nearby star, and found disruptions that indicate the presence of large planetary bodies. The most plausible explanation is that the gravitational force of one or more planets orbiting in the gap within the ring must be tugging at the dust, thus unbalancing their course around the star in predictable ways. Computer simulations have already shown that such gravitational tides can shape a dust ring into eccentricity, and findings from another indicate that the eccentric dust ring around the star Formalhaut may be observational evidence for the process. Since no planetary candidates have been spotted near HR4796A yet, the planets causing the dust ring to wobble are probably simply too faint to detect with current instruments. Nevertheless, the Subaru image allows scientists to infer their presence from their influence on the circumstellar dust (Thalmann *et al*., 2011).

Another possibility is to detect infrared radiation directly from a planet. NASA's Spitzer telescope has been able to detect such radiation emanating from 55 Cancri E, a super-hot extrasolar planet twice the size and eight times the mass of the Earth. Detected initially through the transit method, the measurement of infrared radiation can be used as a significant stepping stone in the eventual search for signs of life on other planets (Demory *et al*., 2012). These data pioneer the study of atmospheres on distant planets, and it is hoped that NASA's forthcoming James Webb Space Telescope will apply a similar technique.

## 4.6 A Planet that is Just Right

The discovery of so many planets in such a short time should not be underestimated. Planets of different sizes, including Earth-like planets, multiplanet solar systems, planets around binary stars, and planets within habitable zones have transformed our understanding of planetary formation

and our estimates of how many planets there may be in the Universe. The picture now seems to be that a large proportion of stars have planetary systems of both gas giants and rocky planets.

Nevertheless, caution is still needed. Both in the popular press and in the scientific literature, the headlines are 'A home from home' or 'Earth's twin'. But how special is the Earth, and can we be sure that the planets that we are discovering are capable of sustaining the kind of life we see on Earth?

More than a decade ago, Ward and Brownlee argued that the circumstances that have produced complex life are each unlikely, and in combination this makes the Earth rare (Ward and Brownlee, 2000). Certainly, before we move to a later consideration of biological evolution, we note that planetary mass, stellar mass, planetary formation mechanisms, and other factors all combine in any estimate of whether a planet might be capable of sustaining life. As we have seen, one of the key issues is whether a planet is within the habitable zone (HZ) of its parent star.

For example, the planet Gliese 581d, first discovered in 2007, has shown that it lies well within the habitable zone, where liquid water could exist. However, its neighbour, Gliese 581g, may be a much better candidate, the announcement of which was made in September 2010, though not without controversy. Earlier work on the planets around Gliese 581 had shown only four planets (M. Mayor *et al*., 2009), and debates about the adequacy of the data and its interpretation illustrate that the discovery of planets is a complicated affair.

The claim about Gliese 581g was made by a group led by Steven Vogt and Paul Butler, who said that they had discovered a small planet at a distance precisely in the middle of the HZ (Vogt *et al*., 2010). This was called the 'Goldilocks' planet, and attracted stories claiming that this was the first planet that could support life outside our Solar System. Yet a combination of the fact that there was no evidence for the planet in the earlier data, combined with other scientists questioning of the statistical significance of the new planet, cast doubt on the announcement. The original group, however, then responded, arguing that the planet does indeed show up in the earlier observations if they are analysed properly (Vogt *et al*., 2012).

The argument illustrates just how hard it is to be certain about planets that are relatively near to us. Gliese 581 is only about 20 light-years away. In addition, it highlights an important factor concerning at what level there can be certainty. As planet detection combines observations with theoretical modelling of a system, there is always a chance that data can be interpreted in such a way that it is a false alarm rather than an actual planet.

Critics of the group led by Vogt claim that Gliese 581g had at least a 4% chance of being a false alarm; that is, far above the 1% normally considered a benchmark for planet detection.

If more data and further analysis reduce the False Alarm Probability, then Gliese 581g would be an interesting find. The planet would have a minimum mass of 2.2 times that of Earth, and an Earth Similarity Index (ESI) of 0.92. This ESI is a multiparameter first assessment of Earth-likeness for solar and extrasolar planets as a number between 0 (no similarity) and 1 (identical to Earth). Any planetary body with an ESI value of more than 0.8 can be considered Earth-like in composition, temperature, and atmosphere. An ESI value in the range 0.6–0.8, such as that of Mars, may be habitable but only by simple and rather specially adapted life (Schulze-Makuch *et al*., 2011).

Another 'super-Earth' is Gliese 667Cc, announced in February 2012, with an ESI of 0.85 (Anglada-Escud'e *et al*., 2012). It has a minimum mass of 4.5 times the Earth's, and is the candidate most securely detected up to now within the liquid water habitable zone of another star. The exoplanet absorbs about as much energy from its star as the Earth does from the Sun, which means surface temperatures could be similar. This would allow for the presence on the planet's surface of liquid water, but its actual capability of supporting liquid water depends on many physical properties that are as yet unknown. Statistical extrapolations based on Doppler, transit, and microlensing surveys indicate that such planets should be abundant around main-sequence stars (Cassan *et al*., 2012) like our Sun, the age and mass of which make them stable.

These two planets have been detected by the radial velocity method. Kepler 22b, as we have already discussed, was discovered by the Kepler Space Telescope, using the transit method. It has an ESI of 0.81 and is in the habitable zone, but its minimum mass is 40 times that of Earth. Its size therefore tends to suggest that its surface is predominantly gaseous or liquid rather than rocky, though no-one knows for sure. This raises an interesting question of its suitability for life. Is a rocky surface necessary, or could life exist on a planet covered by an ocean and with a small rocky core?

This question takes us back to Gliese 581, where Gliese 581d was discovered in 2007. It has an ESI of 0.72 and a minimum mass of 5.6 times that of Earth. Its orbit puts it on the cold outer edges of the habitable zone. Does its relatively low mass and orbital distance allow the presence of liquid water? It receives 35% less stellar energy than does Mars, and is probably locked in tidal resonance, with possibly a permanent night side. Under such conditions it may be that it is an ice planet or even unable to

sustain an atmosphere. But here we encounter another complexity in searching for life. Recent climate simulations demonstrate that greenhouse gases could give it a stable atmosphere and liquid water on the surface (Wordsworth *et al*., 2011).

Indeed, as we learn more about extrasolar planets we begin to discover other factors which may need to be taken into account. For example, how big is the HZ? At a recent meeting, Kasting argued that particular atmospheric climates can stabilize the temperature of the planet and then the HZ could be quite wide, so that perhaps a third of all stars are likely to have rocky planets in HZ (Waltham and Dartnell, 2012: 4.26).

As the field develops, even more complexities arise. While our attention has been directed to rocky planets around main-sequence stars similar to our Sun, it may be that planets could be in a HZ around a wide variety of stars. Although the first planets were claimed around a pulsar, you might assume that this was very rare and that such a scenario would not be a likely place for sustaining life. However, there has been some suggestion that white dwarfs might be a good place for a fruitful HZ. Stars not big enough to form a neutron star or a black hole at the end of their lives, end their lives as white dwarfs. White dwarfs are formed when a star such as our Sun finishes burning its available supply of hydrogen into helium. When that happens the star swells to a red giant, the outer gas layers are shed, and the core collapses into a dense object roughly the size of the Earth.

Yet these objects still emit electromagnetic radiation at a variety of wavelengths. This means that they could maintain a HZ for a planet for more than 8 billion years in terms of temperature. Furthermore, a new study shows that an Earth-like planet in a white dwarf's HZ would receive light at the right wavelengths to sustain photosynthesis, and yet not be affected by excessive ultraviolet radiation which would be unhealthy for life (Fossati *et al*., 2012).

We are now beginning to move into a phase which does not simply concern the discovery of planets, nor indeed whether they are in the HZ, but a phase which begins to ask more about what the planets are like in their atmosphere, their surface, and their chemistry, and which planets are conducive to sustaining life over a long period. When we come to their chemical and geological make-up, this involves, at the moment, combining observations with mathematical modelling. A recent interesting example of this has involved headlines such as 'Astronomers Reveal Planet is Made of Diamond'. Again, behind such headlines are more subtle scientific stories. Rocky planets in our Solar System, such as the Earth, are oxygen-rich, with

silicates and iron being the most common minerals in their interiors. When it comes to extrasolar planets, mass and radius measurements are used to constrain the interior compositions of super-Earths (exoplanets with masses of 1–10 Earth masses), and are typically interpreted with planetary-interior models that assume Earth-centric oxygen-rich compositions. But a study of a planet 55 Cancri e, which is about 40 light years away and 8 times the mass of Earth, suggests that its mass and radius can also be explained by a carbon-rich solid interior made of iron, carbon, and silicon carbide, and without a volatile envelope. The study concludes that this possibility may open a new regime of geochemistry and geophysics in extraterrestrial rocky planets, compared to terrestrial planets in the Solar System (Madhusudhan *et al*., 2012).

We need to stress that even these discoveries do not confirm the existence of other intelligent life in the Universe. In 1996, Michael D. Lemonick wrote in *Time*:

> *Perhaps most important of all, the discovery of planets around relatively nearby Sun-like stars implies that our galaxy, the Milky Way, 100 billion stars strong, must be bursting with other worlds and that there is life out there somewhere. (Lemonick, 1996)*

However, the media hype which built the possibility of life from the calculation of the temperature is rather like concluding that soccer is the national sport of a country after being told that it has a lot of green fields. Many more factors need to be examined before such a conclusion is drawn. Even the most optimistic of believers consider that life on the newly discovered planets would have to be very exotic, existing in the upper atmospheres, or deep within the surface where water might be in liquid form.

It is clear that far more observations are needed to reveal other planets and, more importantly, to study their atmospheres and composition. Certainly the next generation of telescopes should be able to detect atmospheric composition through spectroscopy. The question is, then, what should we be looking for that would indicate life?

An interesting test of this is whether from spectroscopy life could be detected on the Earth (Sagan *et al*., 1993, Jones, 2011). The Galileo spacecraft, on its journey to Jupiter and its satellites, was boosted by a ‘gravitational slingshot’ by approaching close to the Earth in 1990 and 1992. The Earth was analysed in three different ways, and it gave clear indications of the presence of life! Galileo’s near-infrared spectrometer analysed spectral lines of certain substances in the atmosphere in the infrared part of the electromagnetic spectrum. Ozone and methane were detected. Oxygen is

difficult to see in the infrared, but ultraviolet radiation from a star gives rise to ozone, which is a strong indicator of the presence of oxygen produced by photosynthesis. When coupled with evidence for methane, which is produced both by microbes and by large organisms, the presence of a biosphere on the planet can be assumed with confidence.

It is interesting to contrast the Earth with its near neighbours. Results from the Venus Express spacecraft indicated an ozone layer high in the atmosphere of the planet, observed by seeing the absorption of starlight through the upper layers of the atmosphere (Massey, 2011). Both Mars and Venus produce ozone, so the presence of ozone itself is not a good enough test of a biosphere. It is the amount of ozone and then the further presence of methane or carbon dioxide that would begin to point towards life.

Galileo also measured the reflectance spectrum, which is the amount of solar radiation the Earth reflects at different wavelengths. A sharp rise in reflectance at a wavelength in the infrared is associated with the presence on Earth of green vegetation. In addition, a rotating planet which has oceans, vegetation, clouds, and ice will have a variation in the amount of reflected light.

Finally, Galileo picked up radio and television! This shows itself as a strong radiation confined to a narrow range of wavelengths modulated in an intricate way.

More recently, Kawahara and Fujii used data from the Earth-orbiting Terra satellite to model the annual variation in light reflected from our planet. They then used this to create two-dimensional maps of the light from hypothetical Earth-like planets with varying surface features (Kawahara and Fujii, 2011). These maps can be compared with the light variations of real exoplanets to figure out the kinds of habitats that they might hold (Fujii and Kawahara, 2012). The method could also reveal whether plants are growing on the distant worlds by revealing the red-edge jump—a distinctive feature of vegetation on Earth.

In the next section we will discuss how the next generation of scientific instruments may be able to do this for exoplanets. Again we need to stress that data need to be interpreted, and we cannot jump immediately to a conclusion that by observing an atmosphere's spectrum we can be sure of the existence or non-existence of life. For example, if the observations do not show ozone, what might that tell us? It could be that we have a habitable world which is not inhabited. Or it could be that it is inhabited but that there are other reasons why there may be oxygen which does not manifest itself in the form of ozone. There might not be

enough ultraviolet from the star to produce ozone from oxygen. Or it may be that the biosphere is in early stage of development and that photosynthesis has not built up enough oxygen, or that the biosphere may be deep below the surface of the planet.

## 4.7 Delays and Cuts: Future Prospects and Problems

The delayed James Webb Space Telescope has long been looked to for extending our knowledge of exoplanets. It is an orbiting infrared observatory that will complement and extend the discoveries of the Hubble Space Telescope, with longer wavelength coverage and greatly improved sensitivity, and the longer wavelengths will enable it to explore mechanisms of galaxy and star formation as well as the formation of planets. The project has been suffering many delays and overspends, and is now working to a 2018 launch date.

One of the JWST's key mission goals is to 'measure the physical and chemical properties of planetary systems and investigate the potential for life in those systems'. It will be able to detect the presence of planetary systems around nearby stars from their infrared radiation. It will be able to see directly the reflected light of gas giants around nearby stars. It will also be possible for it to see very young planets in formation, while they are still hot. Planetary transits will be observed, and the telescope will be able to see the light that passes through the planet's atmosphere, measure its constituent gases, and determine whether the planet has liquid water on its surface.

Meanwhile, the European Space Agency sees its Cheops (CHaracterising ExOPlanets Satellite) mission as a step towards finding habitable planets. It will observe nearby stars that are already known to have planets, looking in particular for smaller planets. It is scheduled for launch in 2017. And yet Cheops is successor to the shelving of two earlier and more expensive planned missions: Eddington, which would have been similar to Kepler, and Darwin, a flotilla of space telescopes that would have analysed the atmospheres of exoplanets.

Indeed, looking for planets and observing their composition is an area which has promised much in terms of new telescopes, but in fact has been the subject of many funding cuts. A decade ago, plans were being made for new space telescopes built on the Moon or in an orbit around Jupiter. These hopes have not been fulfilled, but the diversity of exoplanets revealed through a range of methods has been startling, and has had a great impact on the whole field of SETI.

When asked to comment on Kepler-16b, the planet likened to *Star Wars*' Tatooine, John Knoll, of Industrial Light & Magic, a division of Lucasfilm Ltd, commented:

> *Working in film, we often are tasked with creating something never before seen. However, more often than not, scientific discoveries prove to be more spectacular than anything we dare imagine. There is no doubt these discoveries influence and inspire storytellers. Their very existence serves as cause to dream bigger and open our minds to new possibilities beyond what we think we 'know'. (Knoll, 2009)*

Planets have expanded the imagination of both scientists and the creators of science fiction. If there are many possible homes out in space, might there be life out there also?

Of course, we need to end this chapter with the cautionary word that planets may not be the best places to look for life. In a paper following this theme, Freeman Dyson proposed a search for extraterrestrial life adapted to cold environments far from the Sun, such as the surfaces of Europa, the Trojan asteroids, or the Kuiper Belt objects (Dyson, 2003). To keep warm, using the light from a distant sun, any life-form must grow a system of optical concentrators, lenses, or mirrors to focus sunlight on its vital parts. Any living vegetation will be seen as a bright patch in strong contrast to its dark surroundings, like the eyes of a nocturnal animal caught in the headlights of a car.

This inevitably raises the question of what kind of life we imagine is the object of SETI. To this we turn next.

# 5
# Genesis 2.0? SETI and Biology

As we noted earlier, the strong advocates of SETI tend to be astronomers, influenced by the possibilities given by a vast Universe. Those who tend to be sceptical of its success are leading experts in evolutionary biology, influenced by the unlikely steps needed for intelligence to emerge. Yet what are those steps, and is such a discussion constrained by too much adherence to life as we know it?

The discussion of whether life could exist in very different and exotic forms, from jellyfish-type objects in the upper atmosphere of Jupiter to life so small that we will never see it, is always an easy speculative option. But we need to start somewhere, and the only data we have is our knowledge of the development of life on the Earth. It is to this we need to turn first.

The strategy of exploration described in the previous chapters rests on a key assumption: that a small rocky planet with the right orbit and right atmosphere and liquid water may give birth to life, and that that life may develop over a period of time. The strategy that NASA has been following in recent years has been 'to follow the water' in an attempt to see signs of extraterrestrial life. This is a reasonable strategy. All of our experience of living things points to water as an essential requirement, for it is in water that molecules can dissolve and chemical reactions can proceed. Liquid water also exists in a temperature range that is good to sustain biochemical reactions. Yet, as Davies points out, it can become a fallacy. That is, it is sometimes claimed, when we find water on other planets and moons, that life should exist there too. But this confuses that liquid water is *necessary* for life but is far from *sufficient* (Davies, 2011b: 625).

How does such life appear in the first place? In 1862, Louis Pasteur, trying to win a prize offered by the French Academy of Sciences, raised through a series of experiments a fundamentally difficult question. He showed that if a solution was sterilized and then protected from microbes it would continue to be sterile. The significance of this was to show that life

did not appear spontaneously from inanimate matter. But if that was the case, then how did it appear?

## 5.1 The Origins of Life

In 1953, Stanley Miller and Harold Urey at the University of Chicago performed one of the most famous experiments of all time. They attempted to produce in the laboratory the conditions on the surface of the Earth some 4 billion years ago. They passed an electric discharge (representing lightning) through a mixture of water, hydrogen, methane, and ammonia (representing the atmosphere of the primitive Earth) for one week. The resultant liquid was red–brown, and it was found that it contained several amino acids, the building blocks of all living organisms on Earth. This was an amazing result. It suggested that life could arise spontaneously with the right chemicals and the right conditions (Miller and Urey, 1959b; Miller and Urey, 1959a).

This was strengthened when a piece of asteroid landed in Australia in 1969. Called the Murchison meteorite, after the small town near Melbourne where it fell, it contained several organic molecules, including amino acids. As this asteroid had been orbiting in the inner Solar System since its birth, it indicated that the basic organic building blocks of life existed not only on the surface of the Earth but also in the inner Solar System (Kvenvolden *et al*., 1970). Indeed, one estimate is that approximately three-quarters of those amino acids found in terrestrial life have extraterrestrial counterparts (Weber and Miller, 1981). The Miller–Urey experiment is now questioned as to whether it was a fair representation of the kind of atmospheric conditions on the primitive Earth (McKay, 1991). However, could the Earth have received primitive life from meteoritic and cometary impacts?

Since the middle of the nineteenth century it has been known that certain rare meteorites contain organic chemicals. We now know that molecular clouds of hydrogen in the space between the stars contain a rich variety of organic molecules (Kobayashi *et al*., 2004; Ehrenfreund *et al*., 2011). For example, an analysis of the spectral lines of a gas cloud around the newly formed star G34.3, some 10,000 light-years away, shows that it has enough alcohol in it to make 300,000 pints of beer for every person alive on the Earth every day for the next 1,000 million years!

Molecular clouds in our Galaxy are maternity hospitals for the birth of stars. These organic molecules are formed in the circumstellar envelopes around carbon-rich red giant stars, and then protected to some extent in the molecular cloud out of which the stars form. Also within these gas clouds

are dust grains, and chemical reactions are catalysed by the dust-grain surface, leading to a diversity of organic molecules. These molecules could then seed the surfaces of newly formed planets formed with the next generation of stars.

Indeed, there were periods in the early history of the Earth when its surface was heavily bombarded by asteroids and comets. Not only may these objects have been carrying organic molecules, but the furnace-like temperatures of entry into the atmosphere and impact itself could have caused gases to combine to form organic molecules.

A few scientists have gone further, suggesting that not only organic molecules were delivered from space, but that pre-Darwinian molecular evolution took place in space and that the resultant microbes were then transported to and seeded fertile planets like the Earth. At the forefront of this theory, often known as 'panspermia', were Sir Fred Hoyle and Chandra Wickramasinghe (Hoyle and Wickramasinghe, 1981). They argued that life might have developed in its most primitive forms in space, and then transported by comets onto the surface of planets where it then began to evolve. Alternatively, there would be times when the Solar System passed through a gas cloud and primitive organisms from the cloud entered the atmosphere of the planets. The implication of this is that primitive life is widespread throughout the Galaxy in molecular gas clouds, just waiting to land on a suitable planet.

Another following this line, though perhaps going further, was the molecular biologist Francis Crick, who won the Nobel Prize for his work on the structure of DNA. His view was that life originated not on the surface of the Earth but was sent here by some intelligence. He suggested that micro-organisms were sent here in an unmanned space rocket by a higher civilization billions of years ago (Crick, 1981).

Although such a theory obviates the problems of life originating spontaneously, it creates other problems. It still needs to be asked, however, how the living cells originate in outer space, with some of the extremes of temperature and radiation involved. Furthermore, if they were sent by intelligence, then where did that intelligence come from? And how did that life first develop? We are back to Pasteur's question: how does life develop from inanimate matter? After all, it is a big step from amino acids to accountants!

Since the pioneering work of Sir Fred Hoyle, we know that the elements, such as carbon which are needed for life, were produced in supernova explosions earlier in the history of the Galaxy (Hoyle *et al*., 1956). As a result of this, it is often said that human beings are made from the ashes

of dead stars, or as Carl Sagan put it in the television series *Cosmos*, 'we are all made of star stuff'. Such statements may be factually correct, but they do not mean that human beings are just star ashes or that the process of the emergence of human beings from such ashes is well-understood.

First of all, though Miller and Urey may have made amino acids in their laboratory, there remain questions on how such organic building blocks could be produced in such large numbers and with sufficient concentration on the surface of the Earth. And this needs to happen very quickly. The Earth was formed 4.5 billion years ago, but bacterial life developed within a few hundred million years. By contrast, large multicellular life began to emerge only 1 billion years ago and intelligent life fewer than millions of years ago. This means that amino acids must combine to produce life reasonably quickly in terms of the age of the Earth.

This critical step from abiological molecules such as amino acids to something like a one-celled organism is a giant step that is not well understood. You might say that surely the amino acids just get together by chance in the same way as they were produced themselves? This may sound like a reasonable argument until you realize what is involved. Each living cell contains large molecules such as proteins and the nucleic acids, DNA and RNA. Each protein consists of different sorts of amino acids put together in a very specific order. There are about twenty different amino acids, and a typical protein will contain around 100 of these. These have to be arranged in an exact sequence for the protein to work.

DNA and RNA are even more complex. These nucleic acids are made up of long chains, with upwards of tens of thousands of four different sorts of nucleotides. The sequence of nucleotides in the chains is the genetic code; that is, the basic information that a cell needs to function and reproduce. The arrangement of these nucleotides on the DNA can be copied onto the RNA, which acts as a messenger, and then used by the protein-making machinery of the cell to produce the exact sequence of amino acids in each protein. Therefore, there follows the question of how the DNA and genetic code are produced. How are such long and complex chains formed?

There is a further problem. The proteins which are made under the instructions of the DNA code are required for all of the functions of the cell. This includes the synthesis of the nucleotide building blocks needed for the production of the DNA itself! It is a classic 'chicken and egg' problem! Proteins cannot be synthesized without DNA or RNA, and DNA cannot be synthesized without the proteins acting as catalysts in the building of the nucleotide chains of DNA. As Sir Karl Popper has written: 'Thus the

code cannot be translated except by using certain products of its translation' (Popper, 1974: 259).

Although the building of basic amino acids may have happened spontaneously, the origin of life is very improbable in terms of its spontaneous appearance. Far greater complexity is needed, and that complexity needs to be of a certain kind in terms of specific chemical forms and reactions. Sir Fred Hoyle once commented that the formation of life by accidental molecular shuffling was like a whirlwind passing through an aircraft factory and assembling a Boeing 747 from the scattered components (Hoyle, 1983). This type of analogy has been repeated often, not least among those who want to object to evolution from religious grounds or to promote intelligent design as evidence for God. While giving a sense of the difficulty of the process, Hoyle is misleading in representing how the process happens. John Maynard Smith pointed out that 'no biologist imagines that complex structures arise in a single step' (Maynard Smith, 1986: 49). Richard Dawkins helpfully uses the image of 'Climbing Mount Improbable' (Dawkins, 1996). To look at the achievement of a mountaineer in conquering a high peak, one understands that this consists of lots of smaller steps, trails, and base camps which build one upon another. It is these intermediate steps that are omitted in many popular arguments, and lead to overestimation of the improbability of the entire process.

However, what if there were an environment which would provide sufficient concentration of organic molecules, some mechanism for forming RNA and DNA, and an energy source to sustain such a process? Such thinking is at an early stage, but we are beginning to see that there are several processes that could aid the development of increasingly complex organic systems. For example, minerals could have provided protection, support, selection, and catalysis in achieving greater complexity (Sephton, 2011: 33). Tiny compartments in minerals could house small chemical mixtures, and surfaces concentrate molecules. Perhaps most importantly, in hydrothermal vents hydrogen and nitrogen pass over iron oxide surfaces, generating ammonia which allows the nitrogen to be used in forming biologically useful materials.

Some suggest that a smaller RNA molecule of about eighty nucleotides appeared first, and that this is how life developed. The RNA has certain forms which can act instead of the protein as a catalyst. Laboratory experiments can induce very short RNA-like structures to replicate in certain conditions, such as in hot clays or underwater volcanoes where primitive life is seen. In these places, mineral-rich hot water vents back into the sea with

very high temperatures. It is here that we may find the conditions for the first life (Melendez-Hevia, 2009; Takeuchi and Hogeweg, 2012).

It seems, however, that this process can generate only microscopic organisms. These prokaryotes are classified into two major groups: bacteria and archaea. Archaea were originally thought to live only in inhospitable conditions, but have since been found in all types of habitat. The evolution of larger and multicellular life must have come from a rare and stochastic endosymbiosis between prokaryotes. Such an event gave rise to the eukaryotes (which includes all complex life) on a single occasion some 4 billion years ago. Complex life is therefore not the inevitable outcome of natural selection operating on an enormous population of bacteria over billions of years (Martin *et al*., 2007).

So, we have a complex picture to interpret for SETI, and different conclusions continue to be drawn. Those who believe in life elsewhere in the Universe stress how 'easily' life can develop. They point to the production of amino acids as a process going on throughout the Universe, either in the early stages of planetary development or in the seeding of planets by comets or asteroids. The discovery of primitive life at some stage in the history of Mars would strengthen this view. However, much of this discussion applies only to simple and primitive life. Those who believe that we are alone stress the 'right conditions', and that life which forms in this way is a complete fluke.

Even assuming that it is a straightforward process from ashes to archaea, it is still a long way to proceed from archaea to an accountant.

## 5.2 The Evolution of Aliens

In a recent book, John Gribbin argues that while the Universe may have all the components necessary for life,

> *…it seems likely that Earth-like planets are rare. But even if other earths were common, my view is that while life itself may be common, the kind of intelligent, technological civilization that has emerged on Earth may be unique, at least in our Milky Way galaxy…The Milky Way contains a few hundred billion stars, but almost certainly contains only one intelligent civilization. In that sense, our civilization is alone and special. (Gribbin, 2011: xiv–xv)*

Gribbin stresses some of the astronomically unique circumstances which are necessary (reviewed in previous chapters), from the stability of the Solar System to the presence of Jupiter as 'comet defender'. Yet even these

are not as important as some of the circumstances necessary for the development of intelligent life—a planet rich in minerals and fossils fuels, an asteroid which gives mammals the upper hand over dinosaurs, and the evolution of intelligent beings themselves. He forms a challenging argument. There may be plenty of life in many parts of the Universe, but how do we get from primitive one-celled life to complex creatures?

Complex creatures begin to show up in the fossil record of about 600 million years ago. The general view amongst biologists is that this process of evolution of organisms is fairly well understood. Evolutionary theory claims to explain the origin of complex life-forms by small differences between individuals in a population having 'survival value'. Indeed, the development of genetics in the twentieth century, coupled with Darwin's ideas on natural selection, has produced the 'new Synthesis' or 'Neo-Darwinism', which has many powerful advocates, as an explanation of the emerging complexity of life (Berry, 1982).

Darwin's theory says that favourable variations in animals or plants tend to survive, and that over many generations these small variations lead to new species. It has been built on the evidence of the following:

- The fossil record, which exhibits a progression from simple to complex structures.
- Similar structures in the anatomy of widely different species.
- The modification of plants and animals by breeders.
- Vestigial organs, such as the 'tail' of the human embryo.
- Changes due to geographical distribution.
- The construction of an evolutionary tree through molecular biology.

Genetics has provided the reason for the variations. As we have seen, genes are essentially DNA, and the genetic code is the sequence of the nucleotides which make up its long chain. Occasionally, when the DNA is copied, as when a cell divides, a small mistake happens during the copying process. Alternatively, radiation or poisonous chemicals can affect the DNA structure. This is a mutation, most of which will be harmful, but a very few will be beneficial to survival. As the DNA code leads to the proteins, and the proteins control the entire chemical composition of any living creature, so changes happen which are then 'selected' by the environment if they are beneficial to survival.

Nevertheless, Neo-Darwinism is not without questions (Futuyma, 1984; Ayala and Arp, 2010). There are, of course, those who have attacked it from the standpoint of seven-day creationism or intelligent design (Numbers, 1992; Forrest and Goss, 2004; Coleman and Carlin, 2004;

Witham, 2005; House, 2008; Dembski and Witt, 2010). While a great number of these attacks are spurious, they sometimes pick up on questions concerning, for example, whether the mutation rate is too slow to account for all changes. In the face of such questions, some biologists have adapted the basic picture. For example, the palaeontologist Stephen Jay Gould suggests a 'punctuated equilibrium' model with sudden quite large-scale changes (Gould, 1983).

However, the basic picture of Darwinian evolution, with some modifications, continues to be a good model of geological and biological data. One of the elder statesmen of biology, Ernst Mayr, Emeritus Professor of Zoology at Harvard University, concluded a review of the subject with the words: 'The basic Darwinian principles are more firmly established than ever' (Mayr, 1991).

Perhaps the most aggressive proponent is Richard Dawkins. For him, Darwinian selection is blind:

> *Natural selection, the blind unconscious, automatic process which Darwin discovered, and which we now know is the explanation for the existence and apparently purposeful form of all life, has no purpose in mind. It has no mind, and no mind's eye. It does not plan for the future. It has no vision, no foresight, no sight at all. If it can be said to play the role of watchmaker in nature, it is the blind watchmaker. (Dawkins, 2000: 5)*

The Divine designer is dethroned by the blind watchmaker. That is, there is no innate drive to complex life, intelligence, and consciousness. We are simply for Dawkins, 'gene survival machines'. In a memorable phrase of the Nobel Prize-winning molecular biologist Jacques Monod, each individual evolutionary step is pure accident, 'chance caught on the wing'.

The implication is that complex life is highly improbable, not to be repeated elsewhere. It depends very sensitively on the right conditions, and in the end is just a fluke. This is a depressing conclusion for those who are attracted by the thought of alien life.

## 5.3 The Inevitability of Life?

Might there, however, be some more nuanced way between the perfect watchmaker of intelligent design and the blind watchmaker of random, undirected evolution? Is there any source of optimism for those who pursue SETI?

There are some who do see life as inevitable. Christian de Duve thinks life is a 'cosmic imperative', more or less bound to occur wherever

Earth-like conditions prevail (De Duve, 1995; de Duve, 2011). His view is that as the building blocks are in plenteous supply throughout the Universe, then life should be too. In passing, it is worth noting that since the clear confidence of de Duve's book *Vital Dust: Life as a Cosmic Imperative* (1995) he now writes articles with titles such as 'Life as a cosmic imperative?' The question mark now acknowledges some of the uncertainties in the field!

Yet this type of argument needs quite a lot of force if it is going to be convincing to many biologists. As we have seen, the formation of amino acids may be easy, but it is a difficult process to form more complex structures.

In a more radical way, Stuart Kauffman, a theoretical biologist, says that the emergence of life was not some chance event, but something that was bound to happen under the conditions of the primitive Earth (Kauffman, 1995). Kauffman uses complexity theory to suggest that when a system reaches some critical level of complexity, it naturally generates a degree of complex order. Thus nucleotides, lipids, and amino acids in the chaotic and complex mess of the primordial soup would become an integrated system. Under such conditions, he says, self-replicating 'life-like' order is not a chance occurrence but an inevitable outcome.

Using a computer model, Kauffman shows that a group of molecules at a critical level of diversity can spontaneously form an 'autocatalytic set', which replicates as a group and evolves to create ever more complicated members (Kauffman, 1986). On this basis he extends the model to say that any sufficiently diverse mix, whether it is of carbon compounds or particles in an intergalactic dust cloud, will form autocatalytic sets, live, and evolve (Cohen, 1998).

The physicist Paul Davies joins these voices against the pessimism of the enormous improbability of the emergence of life and intelligent life elsewhere in the Universe (Davies, 1998; Davies, 2000). He pursues the view that if matter and energy have an 'inbuilt' tendency to amplify and channel complexity, the odds of subsequent evolution of life and intelligence are reduced dramatically. Thus, complexity can arise spontaneously through the process of self-organization.

Some would argue that although the probability of intelligent life is so small, if the Universe is infinite, then you are bound to fulfil all probabilities, and so there must be other life. Davies rightly dismisses this argument on the grounds that if this is so, where do you stop? As he points out, an infinite Universe means not only other life, but another 'this life, this author, and this book'!

He suggests that the standard view of biology—that intelligent life is highly improbable—is built on two underlying assumptions. The first is the Second Law of Thermodynamics, which was formalized in the work of Lord Kelvin and Rudolph Clausius in the nineteenth century. This recognizes that the amount of disorder (given the name 'entropy') in a closed system always increases. It is a law which is generally accepted to be universal. The general trend is that the Universe is slowly dying. Taking this as the dominant world-view, evolution to complex life and intelligence is seen as going against this as a statistical fluke.

The second is that since the controversy over design of nature by God or natural selection in the nineteenth century, biologists are extremely wary of any 'guiding hand', whether it is divinity or even a law of nature which gives direction to a process.

Davies sees such a view as an intellectual cop-out. In particular, it does not address some fundamental issues. What is the link between intelligence and the Universe? There are suggestions from quantum physics that it is the intervention of the observer's conscious mind which forms the link between the uncertainty of the quantum world and the certainty of the everyday world. Furthermore, why is it that the basic physical laws which permit such complexity as life to develop at all seem to be special in their form, and why can we humans understand them?

He is struck very much by these things:

> *. . . consciousness and our ability to do mathematics is no mere accident, no trivial detail, no insignificant by-product of evolution that is piggy-backing on some other mundane property. It points to . . . the existence of a really deep relationship between minds that can do mathematics and the underlying laws of nature that produce them. We have a closed circle of consistency here; the laws of physics produce complex systems, and these complex systems lead to consciousness, which then produces mathematics, which can encode in a succinct and inspiring way the very underlying laws of physics that give rise to it. And we can then wonder why such simple mathematical laws nevertheless allow the emergence of precisely the sort of complexity that leads to minds—minds and mathematics—which can then encode those laws in a simple and elegant way. It is almost uncanny: it seems like a conspiracy. (Davies, 1995: 84)*

For this 'conspiracy' he then begins to resurrect a view similar to that proposed at the beginning of the twentieth century by philosophers such as Henri Bergson and William James, who believed in a force which represented the continuously creative nature of reality.

The belief that life is 'written into' the laws of nature is sometimes called 'biological determinism' (Shapiro, 1986; Fox, 1988). Yet Davies does not go for strict biological determinism. For him, new advances in understanding chaos in physical systems are important. Chaos shows a link between randomness and order and the phenomenon of self-organization. It occurs in lasers, turbulent fluid eddies, chemical reactions, and the formation of snowflakes. Davies' argument is that if such spontaneous self-organization happens in physical systems, we should expect it in biological systems too. Here his ideas resonate with those of Kauffman.

This is not to say that there is some preordained goal, but simply that the trend from simplicity to complexity seems to be built into the laws of nature. In contrast to the Second Law of Thermodynamics, there is some form of an organizing principle—an anti-entropy which means that life does evolve regularly. The self-organization means that the odds against the formation of life and the subsequent evolution of intelligence are drastically shortened.

But Davies wants to go further. He is interested in how chance variations can lead to ordered evolution. One possibility is that quantum mechanics may have a more direct role to play in life than merely providing the mechanism of chemical bonding (Fröhlich, 1983). For example, McFadden points out that certain mutations occur as a result of quantum tunnelling, events in the pair bonds within DNA. He conjectures that the biological environment might 'select' certain mutations by affecting the tunnelling probabilities. In this picture, competing quantum transitions with biochemically very distinct consequences might have very different transition rates, so that adaptive mutations might be quantum mechanically favoured. Applying this to biogenesis, it is possible to imagine that states that are in some sense 'more lifelike' (for example, more complex, more organized, more information-rich) might also be favoured (McFadden, 2001).

For Davies, these ideas hint that perhaps quantum mechanics can 'fast-track' a chemical soup to complex biologically relevant states. Davies has a much softer version of biological determinism. The subject remains hotly debated but has some supporters, such as the astrophysicist and leading proponent of extraterrestrial life, (the late) Carl Sagan. Davies suggests that some biologists are beginning to prefer this option, though it must be stressed that this is not a majority view (Allen, 1984; Davies, 2000; Heschl, 1996; Sedjo, 1996).

Of course, with only the example of life on Earth it is impossible to be definite from one case. However, it has become clear in recent years that many systems in nature, in certain circumstances, leap to states of

greater complexity. It is as if greater complexity is preferred. It seems also that life on Earth arose very quickly, only a few hundred million years after the planet formed. Primitive life existed in a difficult environment subjected to volcanic activity, bombardment by asteroids, and variable solar activity. The development of life on Earth certainly happened quickly in difficult circumstances. Does this mean that life was an inevitable outcome of the outworking of the laws of physics and chemistry, given the right conditions?

This can be viewed in two different ways. Firstly, self-organization works in a general way, depending on the conditions. When this complexity crosses a certain threshold the system may be said to be living. There may be many ways that such organization can take place, so there may be a vast variety of different life-forms in a vast range of conditions. On this view, life may be very different from life on Earth, and the conditions may be not so important; for example, there may be no need for liquid water.

On the other hand, the processes could be much more focused in producing life very similar to the way life is on Earth. This would demand very similar conditions to the Earth in terms of liquid water and the right temperature range.

Whichever way, Sagan and Davies therefore would expect the same general trend elsewhere apart from the Earth. Due to this inbuilt tendency, life would be beginning throughout the Universe. Indeed, Davies argues that the inevitability of life would 'be immediately verified if we were to discover a second sample of life that we could be sure arose from scratch independently of known life' (Davies, 2011b).

What can be said of this kind of proposal? Davies is quite clear that he bases it on three philosophical principles, which we have already met with in this book in the history of the discussion of science, religion, and SETI.

1. *The uniformity of nature*. The laws of nature are the same throughout the Universe. This, in fact, is a basic assumption of science. If the laws of nature were different in a different galaxy, then an understanding of the Universe as a whole would be almost impossible.
2. *The principle of plenitude*. This simply states that whatever is possible in nature tends to become realized. This was a very popular philosophical assumption until the middle of the nineteenth century. Its large-scale demise in the biological word came about when it was realized that many species became extinct and gave way to other species. Rather than all possible species existing together, some were just part of the evolutionary track to other species. Others simply died out with no apparent

long-term survival. The use of the principle of plenitude is somewhat controversial in the discussion of extraterrestrial intelligence. It can surely be used only if some 'law' of increasing complexity leading to intelligent life is already accepted.

3. *The Copernican principle*. This states very simply that we have no special place in the Universe. Some, including Davies, go on from this to argue that this means that there is nothing special about its biological circumstances either. But this is a matter of debate. The circumstances of the Earth may be just right in a whole number of ways to make possible the emergence of extraterrestrial life. Our very presence may be saying that we are in some way special in our circumstances. Recognizing this has been basic to an understanding of the anthropic principle.

By joining these three principles together, Davies, with insights into quantum theory, chaos, and the self-organization of some systems, argues for life elsewhere in the Universe, though he is cautious about going the whole way to intelligent life.

It is interesting to observe that this 'innate tendency in the laws of nature to bring forth life' has parallels within religious thought: in particular, those Christians such as the American geologist Asa Gray, who saw God directing and causing the process of evolution (Livingstone, 1987). Certainly, if it were shown that such a tendency was present in the laws of nature, it would raise the question of why should this be so. Perhaps Davies' 'conspiracy' is divine creativity.

It is at this point that Cambridge palaeontologist Simon Conway Morris has raised some significant questions about the development of life, and in doing so provided some interesting questions for SETI.

He argues that within the evolutionary process there are convergences; that is, different evolutionary lines independently lead to the same structures such as flight or the development of the eye. The eye seems to have evolved independently at least forty times, with a number of different designs. If a human eye is compared to the eye of an insect, they are very different, even though they serve the same function. In fact, there is some evidence that there is deeper genetic connection in the development of eyes which means that they are not totally independent (Quiring *et al*., 1994; Halder *et al*., 1995).

Conway Morris accepts that the fitness of the environment influences the molecular basis of life and the resultant biochemistry, but is cautious about extending this to complex systems. Rather than agreeing with the widely held view that complex organisms are effectively fortuitous

end-products of a process with an almost indefinite number of trajectories, he stresses the role of evolutionary convergences. In his words, that is 'how the universal meets the inevitable' (Conway Morris, 2003; Conway Morris, 2008a).

Many within evolutionary biology see it as entirely open-ended, so that the emergence of human beings is an evolutionary accident. Gould suggested that if the tape of life were to be rewound and started again it would come out completely different; but Conway Morris wants to point out that there are some constraining boundaries in the process. Williams and Fraústo da Silva have argued that thermodynamics and the rules of chemical assembly impart a strong directionality to evolution. Here chemistry combines with the challenger of oxygen and cooperative interactions in the context of ecosystems to make the emergence of eukaryotes inevitable, but also plants and animals (Williams and Fraústo Da Silva, 2003). Conway Morris goes further to suggest that there is clear evidence of evolutionary convergences in viruses, genes, phenotypes, and where complex structure is 'built' by the recruitment of similar genetic modules. This means that navigation by evolution is predetermined by much deeper structures that effectively define a road-map for life. This road-map consists of assembly rules for proteins to the nature of adaptive communities.

If this is the case, not only does it have implications for those who want to reimagine a creator God working purpose out in the midst of the apparent randomness of evolution, but it also means that there may be universal processes that might produce life with some similarities to life on Earth. Conway Morris illustrates this by considering a list of photosynthesis, chlorophyll, chloroplasts, water-conducting tissue (xylem), flowers, and a rose garden. While some biologists might see photosynthesis and chlorophyll as universal (Wolstencroft and Raven, 2002), the rest of the list would be regarded by most biologists as a series of fortuitous evolutionary innovations, of only terrestrial significance. However, gathering evidence that chloroplasts may have arisen independently several times, xylem has evolved twice, and flowers have evolved twice (Ligrane *et al*., 2002; Stiller *et al*., 2003), Conway Morris concludes that we might need to be cautious and say only that the rose garden is unique.

Evolutionary convergences suggest that the motors of adaptation and ecological diversification make the emergence of complex biological systems—say an eye seeing a rose garden—very probable, and perhaps inevitable. The basic similarity of these analogues indicates that radical, alien alternatives may be much less likely than is often thought. In brief, wherever there is life, there will, in due course, be mind (Conway Morris, 2008b).

This is an interesting proposal, and leads to asking: what is the relationship between life, intelligence, and consciousness?

## 5.4 Intelligence and Consciousness

In all of this discussion so far we have tried to make clear the distinction between life and intelligent, self-conscious life. The distinction is often confused. When people talk of other life in the Universe they really mean intelligent life in the Universe, as they would want some communication with this life. Of course, the discovery of any other kind of life in the Universe would be clear evidence that the development of life would not be entirely random. By implication, it could then be said that the development of intelligence would not be entirely random either.

Some thinkers during this century have gone further and pictured the inevitable development from amino acids to single-celled organisms to complex living creatures and then to human-level intelligence. But that does not necessarily follow. Indeed, as we have already pointed out, life on Mars, if confirmed, did not evolve to the state of employing accountants to audit the cost of building all the canals!

The emergence of intelligence on the Earth was dependent on such things as the onset of photosynthesis, the emergence of cells, the growth of multicellularity, the arrival of sex, and the invasion of the land at the most basic level. This is not even to mention things such as the development of a nervous system and other essential organs.

It is often argued that natural selection will lead to growing intelligence. This is because intelligence gives an advantage in the struggle for life. However, this is too simplistic. Barrow and Tipler have argued the case strongly in terms of lineages; that is, strands of development in the evolutionary picture:

> *…it is not intelligence alone which generates selective advantage; a sophisticated nervous system requires a huge number of support systems…to be effective. It is quite possible that no lineage on an Earth-like planet will evolve the necessary support systems for a human-level intellect, and possible that even if they do, the genetic coding of the support systems will be such that an increase in the complexity of the nervous system will be necessarily offset by the degeneration of some essential support organs in all the possible lineages on the Earth-like planet. (Barrow and Tipler, 1986: 129)*

There are many science fiction stories which postulate plants, reptiles, and sea creatures with human-like intelligence. However, on Earth there has

been very little development in intelligence in these lineages in comparison with human beings. For example, the ratio of brain-weight to body-weight, which is thought to be a good measure of information-processing or intelligence, seems to have developed to a certain degree in sea creatures and then stopped. This has been the case with dolphins, squid, and octopuses. Furthermore, it may be that intelligence is a hazard to survival rather than a help. A complex nervous system needs a longer time for gestation in the womb, and then for developing by the teaching of the young. At both times the hazard to the individual is greater.

Thus, intelligence does not seem to have an inevitable progression and does not seem to have a survival advantage in its own right. In conclusion, Barrow and Tipler quote a leading evolutionist, C. O. Lovejoy:

> *…man is not only a unique animal, but the end product of a completely unique evolutionary pathway… We find, then, that the evolution of cognition is the product of a variety of influences and preadaptive capacities, the absence of any one of which would have completely negated the process, and most of which are unique attributes of primates and/or hominids. Specific dietary shifts, bipedal locomotion, manual dexterity, control of differentiated muscles of facial expression, vocalisation, intense social and parenting behaviour (of specific kinds), keen stereoscopic vision, and even specialized forms of sexual behaviour, all qualify as irreplaceable elements. (Lovejoy, 1981: 326)*

There remains an enormous difference between humans and the rest of the natural world. There is much which is still a mystery and needs further work. Michael Ruse comments: 'nothing yet… even scratches at an explanation of how a transformed ape could produce the magnificence of Beethoven's choral symphony' (Ruse, 1982: 264).

In all of this we need to hold a clear distinction also between intelligence and self-consciousness. Some animals have conscious experience and limited mental ability. Opinion is split on whether we can or will ever be able to understand consciousness. Daniel Dennett, one of the leading thinkers in this field, wrote a book with the bold title *Consciousness Explained* (Dennett, 1991), though was subsequently a little less confident with the titles *Kinds of Mind: Towards an Understanding of Consciousness* (Dennett, 1996) and *Sweet Dreams: Philosophical Obstacles to a Science of Consciousness* (Dennett, 2005)! Nevertheless, Dennett's view is that as we understand the neuroscience of the brain more, so we will understand consciousness.

However, this remains a controversial claim (Fahrenfort and Lamme, 2012; Sturm, 2012), even to the extent that some invoke quantum theory in

the explanatory framework (Baars and Edelman, 2012). The philosopher Roger Scruton argues that Dennett describes only consciousness, but not self-consciousness. There is a difference between possessing information and having an awareness of what is involved in possessing it. The philosopher David Chalmers agrees. He believes that there is 'an extra, irreducible ingredient' to self-consciousness (Chalmers, 1996; Chalmers, 1998).

If this does not add immediately to the pessimistic scientific view for the believer in extraterrestrial intelligence, it does increase again the complexity of the discussion. For example, chimpanzees can be trained to use deaf-and-dumb sign language. However, this comes nowhere near to the human ability for self-reflection. How does this develop?

If some of the earlier questions about the origin of life seemed complex, this is perhaps even more difficult. Indeed, it is a subject of great debate between scientists and philosophers, and has been so for many years. What is the relationship between mind and brain? And what do we actually mean by consciousness? As Stuart Sutherland puts it: 'It is impossible to specify what it is, what it does, or how it evolved. Nothing worth reading has been written about it' (Sutherland, 1995: 95).

Many within the dialogue of science and religion see the development of neuroscience as one of the main foci for the dialogue for the next decade. This is a new field combining experimental psychology, comparative neuropsychology, and brain imaging techniques. We already are understanding the tightening relationship between mind and brain, or as Malcolm Jeeves puts it, the 'irreducible interdependence of mind and brain' (Jeeves, 2004). Work in this area is going to be extremely important for the SETI debate, and it is as if we are just at the moment seeing the tip of the iceberg.

As religious thinkers have encountered this area, it seems clear that there are two dangers to avoid. The first is a kind of reductionism that says that consciousness is nothing but the firing of neurons in the brain. Mind is completely dependent of the firing of those neurons, but is more than that. At the other extreme is the danger for Christians to argue strongly again for the existence of a soul in order to solve the problem. Indeed, the question of whether aliens have souls is often discussed in popular literature and science fiction. It seems to me that this is misguided.

Murphy rightly suggests that the tightening of the mind/brain link in neurobiology makes it more improbable for such an ontologically separate entity as the soul to exist, and this has become increasingly popular in much contemporary theology (Pannenberg, 1991–98; Miller, 1994; Booth, 1998; Murphy, 2000; Miller, 2004). In addition, there has been a significant movement in biblical theology in seeing the human person as

a psychosomatic unity. The Greek tradition of an immortal soul, it is claimed, has been imposed onto the biblical texts (Green, 1999a; Green, 1999b; Green, 2002; Edgar, 2000; Berger, 2003). Alongside this, feminist theologians have emphasized the importance of embodiment and the value to God of the physical (Ross, 1993; Ross, 1998). In addition, work in situated robotics and indeed the philosophy of mind takes the physical interaction between body and the world to be essential to intelligence (Brooks, 1991; Clark, 1997; Boden, 2000). Embodiment is central to both self and intelligence, through the self-extending into our physical and cultural environment. The temptation to explain self-consciousness by appeal to a soul or to speculate on non-embodied ETI seems a step too far, even at this early stage.

## 5.5 Life, but Not as We Know It

Of the many great *Star Trek* lines, 'it's life Jim, but not as we know it', has sunk deep into the popular consciousness. In fact, it was never uttered in the original series but became known through a pop song *Startrekkin'*.

Yet it sums up a sense of unease that many people feel in this kind of discussion of the nature of alien life. It is often attacked on the basis of 'carbon-based life imperialism'. What about the possibility of other forms of life not based on carbon or even on planets? Of course, in all the above discussion it is assumed that life is based on the carbon atom. There is a great love in science fiction circles for the claim that life elsewhere in the Universe could be based on silicon, some exotic form of matter, or even plasma. It is not at all clear whether such life is possible, and indeed such a claim can be a licence for anything. As carbon is abundant in the cosmos, and we do know at least one planet of carbon-based life forms, it would seem a reasonable assumption to restrict our discussion at this point to such life. If we encountered a different form of life, then we could modify the assumption. The difficulty is, however, that at the moment we only know of carbon-based life. This is not to avoid the point, but simply to recognize that it is all we have to work with.

However, the search for life 'as we know it' has been receiving some modifications. Recently we have been pushed on this issue with the discovery and study of extremophiles, which are microbes that are capable of different degrees of adaptability to an extreme range of conditions (Madigan and Marrs, 1997; Cavicchioli, 2002; Kounaves, 2007). For example, in the black smokers in the Gulf of California, *Methanopyrus kandleri* is capable of reproduction at temperatures greater than 100° C. Other extremophiles

can thrive in contexts where radiation, acidity, salinity, pressure, and different amounts of water and oxygen would make other life impossible.

This may mean that life exists on Mars and in other places in the Solar System in very different forms (Cockell, 2011; McKay, 2011). For example, Europa is one of the large moons orbiting Jupiter. Observations suggest that it has 100 kilometres of deep icy material covering a rocky surface. But it may be that sufficient heat is generated in Europa because of the tidal stressing as it orbits Jupiter—a kind of internal friction—and that between the rock and ice is a liquid ocean (Keszthelyi, 2011). Might this be a place of primitive life? Another case may be indicated when the Cassini spacecraft discovered jets of water vapour venting into space from Enceladus, a moon of Saturn (Dougherty *et al*., 2009). Here was direct evidence for the existence of reservoirs of water under the icy surface. Further analysis indicated a salty ocean containing simple organic molecules.

Also orbiting Saturn is Titan, the only moon with a dense atmosphere (Kolvoord, 2010). The Voyager spacecraft identified that the majority of the atmosphere was nitrogen, but with organic molecules such as methane, ethane, and propane (Sagan *et al*., 1992). ESA's Huygens probe landed on the surface of Titan in 2005, and combined with Cassini's observations it is now clear that the moon has hundreds of times more liquid hydrocarbons than all the known oil and natural gas reserves on Earth. The hydrocarbons rain from the sky, collecting in vast deposits that form lakes and dunes.

Liquid water on moons far from the Sun, and lakes of hydrocarbons, do raise the possibility of life, but again it seems it would be only primitive life. Yet Rees cautions that we must ensure we are not prejudiced about what forms life might take (Rees, 2003b). Cohen and Stewart, unlike Conway Morris, argue that life will take immensely diverse forms, emerging in a variety of environments (Cohen and Stewart, 2002). Freeman Dyson saw that a Universe ending in a Big Crunch would mean that life would come to an end. However, in an open Universe, he suggested, biological life would adapt first through genetic engineering to redesign organisms that could cope in such a Universe. He was struck by the ability of intelligent life to manipulate the environment of the Earth. Extrapolating forward, he concluded that the combined resources of natural and artificial intelligences should be able to maintain some form of life in the Universe over the next trillion years (Dyson, 1988; Dyson, 1979). Human consciousness would be transferred to new kinds of hardware that would be able to cope with the ultra-low temperatures of a heat-death Universe, including, for example, a complex dust-cloud. Such a cloud could maintain itself for ever (needing to hibernate for long periods) and collect an endless amount

of information. Thus he concluded that 'life and intelligence are potentially immortal'. In a similar way, Fred Hoyle imagined a living structure in his novel *Black Cloud* (Hoyle, 1960). Could such living structures survive at lower temperatures, either on a planet or floating through interstellar space?

Within SETI there has been a dominant methodology based on the assumption that life would evolve and be sustained by planets. However, advances in nanotechnology and artificial intelligence have inspired speculations on the nature of post-biological intelligences and their possible detection (Shostak, 2010), while Davies has suggested that we seek evidence of alien biospheres commingled with our own (Davies, 2011a). Such scenarios might lead to new search strategies, but the difficulty remains that this continues to be largely speculative, and we have to start somewhere. SETI is still anthropocentric in its assumptions of life being carbon-based and evolving to intelligent self-consciousness in a way that we would recognize. As Drake notes:

> *The example of our own existence and history is a prime, yet obviously limited, source of guidance. Although limiting, it encourages scientists to at least think about what other possibilities there might be, and to search for phenomena that broaden our view. (Drake, 2011: 634)*

Consideration of carbon-based self-conscious life, with a few exceptions, leads to pessimism for SETI, not least in trying to articulate what intelligent self-conscious life might be. Furthermore, if the evolution of intelligent life at a level comparable to human beings is so improbable, then it is unlikely to have developed on any other planet in the entire Universe. The emergence of life does not necessarily imply the development of intelligence. If certain things have to be just right for the first bacteria, then a whole series of other things need to be just right for the development to intelligence. Cells needed to combine to form viable bodies, and then nervous systems needed to develop in complex bodies for the emergence of animal intelligence. After that, it took about 250 million years before human intelligence emerged. Unless evolutionary convergences mean that in some way the emergence of mind is written into the universal laws of physics, in a Universe teeming with life, we could still be alone. Consideration of other exotic forms of very different life may lead to optimism, but are extremely speculative—and would we ever recognize them as intelligent life?

In a recent article, Conway Morris puts it starkly. Building on his belief that the outcomes of evolution are predictable, he is led to two opposite

possibilities. The first is that alien biospheres will be strikingly similar to our terrestrial equivalent, and that in such biospheres intelligence will inevitably emerge. But the second possibility is that the first possibility is extremely unlikely and that we and our biosphere are completely alone (Conway Morris, 2011).

The only way to determine whether we are not completely alone and tie down speculation about the nature of other forms of intelligent life would be to find direct evidence of such life. It is to this we turn next. However, as a Calvin and Hobbes cartoon once put it: 'Sometimes I think the surest sign that intelligent life exists elsewhere in the Universe is that none of it has tried to contact us!'[1]

[1] <http://www.gocomics.com/calvinandhobbes/1989/11/08>

# 6
# Looking for a Needle in a Haystack: Current SETI Strategies

In 1959 an article was published in the journal *Nature* titled 'Searching for Interstellar Communication', by Giuseppe Cocconi and Philip Morrison (Cocconi and Morrison, 1959). It was the first scientific paper to suggest surveying nearby stars for microwave signals which may have been sent by intelligent beings. As the paper was published, the young radio astronomer Frank Drake was independently about to carry out such a survey (Drake, 1960). So the modern era of SETI was born.

## 6.1 Searching for Interstellar Communication

Science is a subtle interplay of theoretical speculation and observation. This interplay happens in what the philosopher of science Michael Polanyi called the 'tacit skills' of science—the interpretation of data, construction of models, judgements about the weight of evidence, and decisions about research direction. These are exercised by individual scientists within a community context of peer review and funding regimes (Polanyi, 1958). SETI is a prime example of such a process, not least in the way that funding and theoretical speculation both enables and constrains observation.

As we have seen, searching for evidence of extraterrestrial intelligence is not at all easy. The previous chapters raise the question of how we would actually confirm the existence of extraterrestrial intelligence. We could see evidence for a biosphere on distant planets, and we might convince ourselves that in theory there are many civilizations out there. But communication with extraterrestrials remains the one way that we could be sure of their existence and indeed their intelligence.

This, however, is not a trivial task. As we have seen, there are at least 100 billion stars in our Milky Way galaxy, and the Earth is bathed in a flood of electromagnetic radiation. If we wanted to communicate with

aliens, which frequency band should we use or monitor? There are millions of different frequency bands that radio communication could use. A small insight into the problem is trying to tune a domestic radio into a specific radio station without any knowledge of its frequency or waveband. And what if you are doing it at a time when you do not recognize the program that it is broadcasting, or even more seriously, if the station itself has closed down transmission for a period? It is a somewhat frustrating experience.

Magnify that problem a great number of times, and it can be seen that simply pointing a radio telescope randomly at the sky is a start, but nothing more than that. Even with unlimited resources—which, of course, are never available—this appears to be like looking for a needle in a haystack. Then there is the problem of recognizing the message. In *Star Trek IV: The Voyage Home,* Kirk and his crew are confused by a message from an alien spacecraft directed at the Earth until they realize that it is a message in whale song!

However, in 1959 Cocconi and Morrison attempted to reduce the haystack. They suggested that if aliens were trying to communicate with us, then they would choose an obvious frequency to do so. They further suggested that the frequency would be 1420 MHz, corresponding to a wavelength of 21 cm. This is the frequency at which hydrogen, which comprises more than 70% of the matter in the Universe, radiates radio energy. This is the same as the principle of television advertising. Put your message on a channel that you know people will be watching. Now, it does not have to be exactly 1420 MHz; it could be a multiple of this frequency, but at least you now have somewhere to start. Indeed, Carl Sagan suggested that to distinguish communication from the natural signals we might want to broadcast or monitor at a frequency of 1420 MHz multiplied or divided by $\pi$. Since this is a universal number, alien intelligences might have the same idea. This is an important concept. It illustrates that the universal laws of physics may provide the common ground for communication (Sagan, 1978).

Frank Drake began the search by observing two nearby stars at 1420 MHz. Nothing was found, but the possibility of finding an alien message out there became scientifically feasible. Since then there have been numerous small-scale attempts to detect signals from extraterrestrial civilizations, and radio astronomers have searched large sections of the sky without success. The only exception has been one unexplained signal in 1977. It was called the 'Wow' signal after the startled researcher at Ohio State University scribbled the word on a printout. This signal has not been seen again, but to some has not been satisfactorily explained (Brooks, 2008).

Even reducing the size of the haystack, the SETI challenge remains formidable. The astronomer David Hughes writes:

> *First you have to point your radio telescope in the direction of a star that might be the parent of a planetary system …Then for each star you have to search a radio window that stretches from 1 to 10 GHz and contains 100,000 million 0.1 Hz bandwidth channels. No wonder you are thankful for your computer's Fourier-transform superprocessor; no wonder you are worried about the fluctuations in the background noise resembling an artificial signal. And even overlooking the fact that your search might last for the lifetimes of many generations of scientists, you still have to contend with the fickle nature of scientific funding agencies who are only too happy at times to suggest that you are wasting your time and their money! (Hughes, 1996: 183)*

Not least, in all of these difficulties, is the ever-increasing problem of how to filter out Earth-produced noise such as communication satellites. The search has been helped enormously by modern radio telescopes being able to monitor hundreds of frequency bands simultaneously. But then this raises the problem that all the collected data have to be analysed and searched!

It is unlikely that we might simply stumble across radio or television signals from another civilization, such as those that the Galileo satellite detected when it made a close approach to the Earth (Chapter 4). As these radio waves are not directed at us and they spread out into space, they would be extremely weak—we could only reasonably expect them to be detectable from our closest neighbours in the Galaxy.

If we wanted to communicate we would want to concentrate our energy in a narrow band around some significant frequency and then direct it toward a target of a planet which is in a habitable zone or has markers of a biosphere. But to see an alien signal we would have to turn our receiver to not only the planets that we have discovered so far, but also millions of other stars which may have intelligent life. And then we would have to interpret and understand it.

## 6.2 Discovering and Understanding Little Green Men

An interesting and famous example of this happened in the 1960s. Jocelyn Bell arrived in Cambridge as a research student to work with Dr Anthony Hewish. Her PhD work involved making a radio telescope. This was not the kind of radio telescope such as the large and beautiful Arecibo telescope

in Puerto Rico. In a field a couple of kilometres from Cambridge, Bell and her colleagues erected a lattice of wire and posts with an overall budget of £17,000.

Once the telescope was built, Bell went each day to fill the ink-wells and watch the paper chart churning out about 100 feet per day, as the telescope measured radio signals from the sky which passed overhead. One day in August 1967 she noticed a 'ragged signal' which looked unusual and filled only a quarter of an inch in the hundreds of feet of chart. She checked back, and saw the same signal a number of times in the past records. In November the team saw that the signal was coming from a source emitting regular pulses of radio waves at intervals just greater than 1 second. They were able to calculate that its distance put it within our Galaxy, and that the object emitting the pulses was very small—no bigger than the Earth.

Was it aliens? One of the signs of another civilization trying to contact us would be a regular signal. In fact, Hewish had tentatively catalogued the source as LGM1—short for 'little green men'! Then they were able to see that the source was not a planet orbiting a star. If this had been the case then they would have seen evidence of Doppler shift as it orbited. So if it was aliens, it was not coming from their home planet. Was it a spaceship or a radio beacon?

Bell checked the records and saw other such objects. Did this mean that there were lots of beacons or civilizations? In fact, with further study it turned out to be a natural phenomenon. They had discovered the first pulsar (Hewish *et al*., 1968)—a spinning neutron star. In stars larger than our Sun, the gravitational collapse of its core as it uses up its available fuel is so extreme that at the core the electrons and protons are forced to combine to form neutrons. The matter of the star is forced into a sphere only a few kilometres in diameter. It is so dense that a teaspoon of this matter would weigh 100 million tons. Such objects can spin up to 1,000 million times per second. The intense electrical and magnetic fields of these objects can produce a highly focused beam of radio waves, which appears from the Earth to be short pulses due to the rotation, rather like seeing short pulses of light from a lighthouse.

Bell, though not awarded a share of the Nobel Prize with Hewish, went on to a distinguished career in astronomy, as both scientist and senior leader. Interestingly, she has always been open about her Quaker faith. Speaking of her belief in extraterrestrial life, she comments:

> *One of the tenets of Quakerism is that you should be open to new light, new ideas. In both Quakerism and science you must be completely ready*

> *to revise what you hold to be the truth; you always hold things provisionally, and you are always open to revising them. The Universe is very big—there are about 100,000 million galaxies in the Universe, so that means an awful lot of stars. And some of them, I am pretty certain, will have planets, where there was life, is life, or maybe will be life. I do not believe we are alone. (Moloney, 2007)*

There are interesting resonances again with the history of the relationship of science, religion, and SETI.

However, the story of LGM1 highlights a problem which always dogs the search for extraterrestrial intelligence. Can we be sure that any signal is from an intelligent origin rather than from a natural phenomenon which at present we do not understand?

Furthermore, how could we interpret or understand the significance of a radio signal from an alien civilization. It may be that signals are being transmitted, but we then do not recognize them as intelligent communication. Cohen and Stewart illustrate this by asking whether a radio engineer from decades of the past, at home with the radio technology of amplitude-modulation systems, may not understand at all the signals of FM or digital radio. Thus they suggest that the only type of intelligence we could identify would be something very much like our own (Cohen and Stewart, 2002). This is an interesting parable. Yet it overlooks the consideration that with a basic knowledge of physics it is not a completely impossible task to learn the new technology. It may take a little time, but it is possible. This seems to be an important consideration. If we believe that the laws of physics give us a ground for common knowledge, then there may be a way of recognizing intelligent communication.

Of course, human history is full of examples of finding common ground for communication. When the *Mayflower* landed the first pilgrims at Plymouth in America on 21 December 1620, the story goes that they encountered a strange and alien land. There were nights when the pilgrims could hear the noise of Indian drums, and assumed that they were savages. Affected badly by cold and disease, only half the original 102 passengers were still alive by spring. They survived only because they were helped by Native Americans. Indeed, in April 1621 an Abenaki called Samoset entered the village and said 'Welcome!' (Sylvester, 1910). The obvious puzzle that most people ignore in the story is how they understood what he was saying! In fact, Samoset spoke English. He had been kidnapped by explorers and taken to England, where he had learned the language. Later he returned with Squanto, who had also been captured by English

seamen in 1614, sold as a slave in Spain, and then escaped to England, where he learned to speak English. Squanto would become the pilgrims' interpreter and helper. Samoset and Squanto would have learned English not from a translator or language teacher, but by using common experience such as using names for parts of the body, the world around us, and emotions, among many other things. The common experience of being human becomes the basis of learning language.

While alien civilizations might not share human experience in terms of similar bodies, atmospheric conditions on a planet, or emotions, the universality of the physical laws, could provide the common ground for recognizing, learning, and communicating between intelligences. In particular, dimensionless constants such as π, or ratios such as the ratio of masses of electrons and protons, should be universally known to possible intelligences throughout the Universe. As we saw in earlier chapters, a commitment to the universality of the physical laws had encouraged a belief in the possibility of extraterrestrial intelligence. They may also encourage a belief in the possibility of common ground in communication.

Christian theology sees these universal laws of physics as a reflection of the faithfulness of God in sustaining the Universe and its order. Indeed, fundamental to the scientific revolution was the sense that as God was creator of the whole Universe, then the laws would be consistent in all parts of the Universe, rather than different parts of the Universe being under the control of different gods. This would allow Christian theology to go even further in being optimistic about the possibility of communication. If God was the source and sustainer of all life in the Universe, then in addition to the common ground of the physical laws there should also be the common ground of God himself.

The immediate response to this type of argument is, of course, to point to the divisions that religion has led to with human beings. This is a fair point, though two things may be said in response. The first is that many conflicts use religion to express deeper reasons of political, historical, and socioeconomic differences. Second, there exist remarkable stories of genuine inter-faith dialogue, common purpose, and growing respect in the midst of recognizing difference.

In fact, these arguments featured strongly in a recent *100-Year Starship Symposium*—a meeting to discuss the prospect of sending a space mission to another star within 100 years. Should organized religions have a role, or on a journey to another intelligent civilization should religion be left behind? More practically, one of the contributors simply noted: 'Where humans go, they take religion with them' (Moskowitz, 2012).

## 6.3 SETI Programmes: Bagging Little Green Fellows

In October 1992 a new phase began with great optimism. NASA began a ten-year, $100-million search for extraterrestrial intelligence. It was launched on the 500th anniversary of the arrival of Christopher Columbus in America. Called originally Project Columbus, it quickly became Project Phoenix. This radio astronomy programme attempted to pick up signals from 1,000 nearby stars similar to our Sun, out to a distance of 100 light-years. At the same time, it also attempted to scan further afield to find a message. If aliens are around the nearest stars, then we might pick up their signals in the same way that they were picking up our television signals. Or if aliens were colonizing the Galaxy, then we might pick up some of their radio communication between the stars.

However, such optimism quickly met harsh economic realities. In 1993 the NASA program was closed down by the US Congress. One of its leading opponents, Senator Richard Bryan, called it a 'great martian chase' and 'a waste of taxpayers' money', and pointed out that 'we have yet to bag a single little green fellow'.

Such is the reality and experience of SETI programmes. It is remarkable that a question that holds such fascination for the general public suffers from lack of public funding and commitment from the scientific establishment. The historian Stephen J. Garber comments on the closure of the NASA programme:

> *While there was and still is a debate over the likelihood of finding intelligent extra-terrestrial life, virtually all informed parties agreed that the SETI program constituted worthwhile, valid science. Yet fervor over the federal budget deficit, lack of support from other scientists and aerospace contractors, and a significant history of unfounded associations with non-scientific elements combined with bad timing in fall 1993 to make the program an easy target to eliminate. Thus SETI was a relative anomaly in terms of a small, scientifically valid program that was cancelled for political expediency. (Garber, 1999)*

It may be that political expediency is the dominant reason for the cancellation of SETI programmes. Certainly, the scientific task is huge, and it is difficult to promise success. As Frank Drake says: 'So you cannot guarantee success and you are asking them for a blank cheque' (Waldrop, 2011). But there is also the 'significant history of unfounded associations with non-scientific elements'. At times, might it be that religious prejudices have worked against SETI? Religious groups, as well as encouraging scientific development, have at other times resisted scientific programmes

under banners such as we should not be 'playing God'. In addition, the link of SETI with a subculture of 'X-files'-type phenomena plays against both science and religion. A survey of US and Chinese university students in 2000 showed that those who were more conservative in religious beliefs, the more harmful they considered extraterrestrial contact to be (Vakoch and Lee, 2000).

Since the cancellation of the NASA programme, the search has been continued by privately financed groups. Frank Drake, the founding father of SETI, headed the SETI Institute in California. It was set up as a distinct organization in 1984, and is financed by millions of dollars of private donations. In 1995 the SETI Institute sponsored Project Phoenix, using the world's largest radio telescopes (Tarter, 1997). Up to 2004 it had scanned 800 close-neighbour Sun-like stars, but found nothing, indicating a very quiet neighbourhood.

In 2007 the Allen Telescope Array (ATA) began its work on a range of radio astronomy projects as well as SETI. Large single-dish telescopes such as Arecibo are expensive, and are difficult to extend. The ATA is an array of inexpensive small dishes, manufactured through a process developed for the television industry. The sensitivity of the array is increased by simply adding more dishes. Over time, with sufficient funding, it was planned that the ATA would grow to 350 dishes. It would then have a collecting area equivalent to a single dish 114 metres in diameter and with the angular resolution of a dish 700 metres across. As a comparison, the Arecibo telescope is 305 metres in diameter. In 2001, Paul Allen (co-founder of Microsoft) funded the technology development and the first forty-two dishes. However, the SETI Institute continued to struggle for funds to sustain this kind of development. In 2011 the Array closed due to budget cuts, but was refinanced by further donations.

To try to deal with the issue of cost and acquire valuable radio-telescope time, Project SERENDIP, originally conceived by SETI researchers at the University of California at Berkeley, piggybacks on the work of other radio astronomers by a receiver suspended high above the Arecibo dish, scanning the sky for narrow-band signals wherever it happens to be pointed. It thus uses the world's largest radio telescope to scan billions of stars and thousands of galaxies (Lampton *et al*., 1992). In summer 2006 the project instead began to record data from the five-times-more-sensitive ALFA multibeam receiver, installed at Arecibo in 2004. It looks at seven spots in the sky at once, instead of just one.

The project gave birth to the SETI@home initiative, as the rate of incoming data to be searched far exceeded the computing capacity of SERENDIP.

This initiative, begun in 1999, again shows the public fascination with this question. David Gedye realized that the analysis of SETI radio data could be achieved by 'distributed computing' by volunteers using home computers. The volunteer downloads a program, which unobtrusively acquires files of data from SERENDIP and analyses it when the computer is not fully occupied with other things. It then sends back the results, and downloads more data. SETI@home has been an astonishing success. It has engaged 5 million independent volunteers whose computers constitute the world's largest supercomputer. But even SETI@home is continually seeking donations so that it can continue with its plans. It also needs to be noted that it searches the 21 cm wavelength, which may not be the radio station of choice for alien civilizations.

There have been, and currently are, a number of other searches, including:

- Southern SERENDIP piggybacks on the 64 metre radio dish at Australia's Parkes Observatory, the largest radio telescope in the southern hemisphere.
- Project BETA was started in the early 1980s by Paul Horowitz of Harvard University, using a 26 metre dish until it was smashed in a wind-storm in 1999.
- META II searched using a pair of 30 metre dishes near Buenos Aires, starting in 1990, and is now currently named Southern SETI.
- SETI Italia used a similar SERENDIP approach on a 32 metre dish in Medicina.
- The European agency ASTRON is working on using its LOFAR array (designed for high-resolution radio astronomy at poorly explored, relatively low frequencies) on a SETI project targeting nearby stars.

One of the most interesting developments of recent years has been the realization that it may not be just in the radio part of the spectrum that SETI could explore. In 1961, laser pioneers Charles H. Townes and Robert N. Schwartz suggested utilization of the optical part of the spectrum through laser signalling. This idea was taken forward by Stuart Kingsley, Paul Horowitz, and many others, who in the late 1990s demonstrated that nanosecond laser pulses would be suitable for interstellar communication. This is sometimes called OSETI—optical SETI. A laser could send such a powerful signal that a civilization to which the laser were directed would see a jump in brightness of our Sun that would be obvious to broadband optical detectors. Instead of sifting through billions of narrow radio channels for a signal, we would see a laser signal by watching a single,

wide-frequency channel spanning much of the visible or infrared spectrum (Hanna *et al*., 2009).

In 2004, Seth Shostak of the SETI Institute reviewed the searches to that date and the foreseeable future, and tried to predict when a detection will occur. He reviewed the four decades of radio observation and optical SETI, and possible improvements to the search, and concluded that if the principal assumptions underlying modern SETI are reasonable then it is likely that a detection will occur within a single generation—that is, perhaps by 2027 (Shostak, 2004).

Yet a long search lies ahead. At a SETI workshop in the same year, Guillermo Lemarchand estimated that we had examined only a hundred-trillionth of the radio 'search space' waiting to be surveyed (Beatty and MacRobert, 2004). Nevertheless, whether it is by 2027 or much further in the future, there are many who are already thinking about 'First Contact'.

## 6.4 First Contact

A detected signal would alert us to the existence of other intelligent life, but it may not be direct contact. It may simply be a radio beacon. Of course, the beacon may carry information about the life-form which made it. In a sense, it may be a cosmic message in a bottle.

Pioneer 10—the first humanly constructed object to leave the Solar System—carried a plaque with basic data about human beings and a picture of a man and woman (Hall, 1975). The Voyager spacecraft which explored the outer planets carried more information as they headed off into interstellar space (Abelson, 1977; Rudd *et al*., 1997). In fact, they carried a message from the UN:

> *As the Secretary General of the United Nations, an Organization of 147 Member States who represent almost all of the human inhabitants of the planet Earth, I send greetings on behalf of the people of our planet.*
>
> *We step out of our Solar System into the Universe seeking only peace and friendship; to teach if we are called upon; to be taught if we are fortunate.*
>
> *We know full well that our planet and all its inhabitants are but a small part of this immense Universe that surrounds us, and it is with humility and hope that we take this step. (United Nations, 1977)*

In receiving a message or sending one of our own we need to re-emphasise the difficulty involved in communication. In November 1974, Frank Drake used the Arecibo radio telescope to beam the strongest human-made signal

ever transmitted, in the direction of the Great Cluster in the constellation Hercules. It consisted of a binary message that included numbers, stick figures, chemical formulae, and a crude image of the telescope itself. Sir Martin Ryle, the Astronomer Royal, objected to this, in case it revealed our position to aliens who might then come and conquer! The problem is, however, that such a message may literally have to travel for millions of years before it is received by an intelligent civilization. If the message is understood, a reply could again take millions of years. Indeed, we would not receive a reply to the Arecibo message of 1974 for 50,000 years.

There are some who suggest we should be looking for signs of past 'first contact'. A. V. Arkhipov argued that due to advanced alien civilizations constructing technology in space, there will be, as a result of such things as the accidental explosion of satellites, a leakage of alien 'artefacts' from their solar system into the rest of the Galaxy (Arkhipov, 1998). Some of these artefacts may eventually fall to Earth. He calculates that in its history the Earth might have accumulated about 4,000 artefacts of around 100 grammes. This seems to me to be a somewhat high estimate, for a number of reasons—not least that he assumes that 1% of planetary systems are manufacturing artefacts. This puts the number of advanced civilizations in our Galaxy in the order of at least hundreds of millions—which is even more than *Star Trek*! There is the further problem of how would we recognize whether an 'artefact' was alien? It is unlikely that it would have 'Property of the Klingon Empire' in English stamped on it!

The existence of an alien artefact was the centre of one of the most famous science fiction novels and films ever. In Arthur C. Clarke's *2001: A Space Odyssey*, astronauts on the Moon discover a strange black obelisk. The implication is that it was placed there to be discovered only when human beings were sufficiently advanced to see it. Frank Drake picks up this theme in terms of SETI:

> *If we want to join the community of advanced civilizations we must work hard as they must. Perhaps they will send a signal that can be detected only if we put in as much effort into receiving it as they put into transmitting it. (Drake and Sobel, 1994: 233)*

If effort would be needed in receiving a signal, further effort would be required in interpreting the signal. Morrison highlights the broad nature of this task:

> *The recognition of the signal is the great event, but the interpretation of the signal will be a social task comparable to that of a very large*

> *discipline, or branch of learning. Most of this very complex signal will contain not merely science and mathematics, but mostly what we would call art and history. (Morrison, 1973: 333)*

There will also be questions of how such a social task should proceed. Even at this early stage of SETI, some have begun to think about protocols for first contact (Tarter and Michaud, 1990; Billingham *et al*., 1991; Race and Randolph, 2002; Baxter and Elliott, 2012). After all, how would the peoples of the Earth be represented if communication were established with an alien civilization? Hollywood science fiction sometimes points in the direction of its being a matter for the President of the United States, though as *ET* poignantly points out, it may be that those without political power, such as children riding bicycles, are better representatives of planet Earth. Other protocols involved the reporting of any contact worldwide, that responses should be formulated by international consultation, and that no nation fearing ETI as a threat should act without consultation with the UN Security Council. Scales were devised to try to evaluate the impact on society, which depended on the nature of the phenomenon, the type of discovery, the distance, and the credibility of the claim (Almar and Race, 2011).

It is fair to say that perhaps one of the most important aspects will be how the media deal with such stories (Shostak, 1997). Indeed, Denning rightly suggests that the vast majority of humanity will be dealing not with extraterrestrial life itself but with human perceptions and representations of that alien life. These, she argues, will derive from cultural influences and individual psychology, as well as from science. She goes further to suggest that in most detection scenarios the scientific data (and debates about their interpretation) will be nigh irrelevant to the unfolding of international public reaction (Denning, 2011). This is where the importance of understanding pop culture, religion, and history, in their interaction with SETI, can be seen.

If these are some of the considerations of contact through message, the stakes rise even higher if aliens turn up on our doorstep. Earlier we highlighted the arrival of the first pilgrims in America. Welcomed by the Native Americans, it was not too long before the latter were dispossessed and alienated from their own land. The history of the first contact between different civilizations has often led to cultural imperialism, disease, and extermination.

Again, initial thinking in this area has also led to protocols:

1. A commitment to assume that ETI is benign until proven otherwise, and to treat ETI as envoys with appropriate diplomatic rights.

2. A duty to anticipate dangers associated with such an event, to protect mankind from such dangers, and not to imperil mankind by taking any action without proper consultation.
3. A duty to manage contact with ETI on behalf of all mankind, through an international process and reflecting a broad consensus, respectfully, truthfully, and fairly. (Baxter and Elliott, 2012: 35)

Of course, protocols are all well and good, but they have not been embedded into national or international law. The UN briefly considered the matter in 1977, but little was done (Othman, 2011). Dominik and Zarnecki are probably correct in suggesting that these protocols are likely to be ignored if contact occurs (Dominik and Zarnecki, 2011).

The questions, of course, go much further than first contact. The 'cultural aspects of SETI' has come to mean the longer-term way by which the discovery of ETI would affect culture and civilization, including science, technology, politics, and religions (Billingham, 1998; Regis, 1985; Harrison, 2011). Some of this is difficult to predict, depending on what kind of intelligent life is encountered and how it is encountered.

While such an encounter remains unlikely, many see that it is also a high-consequence event (Almár and Tarter, 2011). But what might those consequences be? Dick has reflected on events of similar significance in the history of science. He argues that rather than the analogy of European colonization of the Americas, the discovery of ETI would play out more like the Copernican and Darwinian revolutions (Dick, 1995: 521–32). This is an interesting suggestion, not least in that the full impact of these revolutions has taken decades if not centuries to play out (Barton and Wilkinson, 2009).

It remains controversial whether contact would be beneficial or harmful for humanity (Baum *et al*., 2011). Some speculate on benefits such as scientific and technological learning, though suggest that collaboration initially would be in the arts and humanities (Harrison and Dick, 2000: 7–29). Others see a more political role, with advanced civilizations intervening to avoid catastrophes on Earth, giving political advice and even forcible corrective action (Tough, 1986). In terms of potential harm, the science fiction scenarios of invasion are not ruled out, but there are a number of voices which express the opinion that a scientifically advanced and long-lived civilization will have moved beyond the reasons for war and aggression (Deardorff, 1986; Harrison, 2000: 107–14). Yet others argue that finite resources in the Galaxy would cultivate aggression in any intelligent species, and that part of intelligent

life is a tendency towards colonization and self-preservation (Ragbir, 2000: 57). The question here is whether technological advances imply ethical or indeed religious maturity. We will return to this in Chapter 8.

It is often thought that the biggest loser in first contact would be the organized religions of the world—in particular, traditional Christianity, because of its perceived anthropocentric nature (Kaufman, 2012). Yet, as we have seen, this may be simply a recent myth, for the history of the relationship between SETI and Christian belief has been more than fruitful. Indeed, surveys of attitudes show a relaxed attitude on the part of individual believers. In a survey of 1,300 people, Ted Peters asked whether they thought that the discovery of extraterrestrial intelligence would shake their individual belief or the strength of their religion as a whole, or would adversely affect the beliefs of other religions (Peters, 2011). The conclusion was that across the different religious traditions (Roman Catholics, evangelical Protestants, mainline Protestants, Orthodox Christians, Mormons, Jews, and Buddhists), the vast majority of believers see no threat to their personal beliefs. Some anxiety increased that their religious leaders might face a challenge, but even so, there was overwhelming confidence that their tradition would not collapse. This was in contrast with those who identified themselves as non-religious, of which 69% thought the discovery would cause a crisis for world religions.

Other surveys have reinforced these results (Alexander, 2003: 359–70). Specific surveys of religious leaders indicate that only a small percentage of them are concerned that the existence of ETI might be in conflict with the beliefs of the members of their faith communities (McAdamis, 2011: 338). Nevertheless, the challenge to certain beliefs would need to be explored.

Religious beliefs are, however, often caught up in culture shock. The conflict between science and religion embodied in six-day creationism was partly a response to the post-Darwinian controversies but also due to the culture wars of twentieth century America (Numbers, 1998). Protestant religion found itself more and more marginalized in public life in entertainment and education, and six-day creationism was an attempt by some to reassert power (Romanowski, 1996).

Michaud has rightly pointed out that any message or contact from an extraterrestrial civilization has the potential to cause a great cultural shock (Michaud, 2007: 233–8). He quotes sociologist Donald Tarter, who predicts that knowledge of extraterrestrial culture and alien theology has the potential to compromise human allegiance to existing organizational structures and institutions. This could happen immediately or be spread over decades.

Harrison makes similar points, speculating that if extraterrestrials shared technology, this could increase the gap between scientific and cultural progress (Harrison, 1997). The point here is that if religious leaders do not learn the lessons of the Copernican and Darwinian revolutions, and indeed industrial and moral cultural shocks, the shock-waves of contact with ETI may shake the foundations of faith and community. In fact, while the Church struggled at times in these previous cultural shocks, it found ways of rediscovering a theology which has not only survived but been true to its biblical roots and fruitful in its mission in a changing world. In this way such a shock-wave could be seen to be an opportunity as well as a challenge.

Such speculation may seem a long way from the reality that after decades of searching we have heard no 'din of alien chatter in our neighbourhood' (Kerr, 2004). Is it that we have missed it? Is it that no-one is there? Or is it because aliens do not want us to hear? The lack of any sign of aliens leads to one of the strongest arguments against their existence, and it is to this that we now move.

# 7
# Fermi's Paradox

At lunch one day in 1950, the physicist Enrico Fermi wondered out loud, and devised what is often called Fermi's paradox, or the space-travel argument against the existence of extraterrestrial life. It is put simply as, 'If they existed they would be here'.

## 7.1 Where is Everybody?

Stephen Webb, drawing on the work of Eric Jones, describes very helpfully what happened on this occasion (Jones, 1985; Webb, 2002: 17). Flying-saucer reports had been numerous in 1950, and New York newspapers were also full of the mystery of the disappearance of public trash-cans. At Los Alamos, while walking to lunch, Fermi, Edward Teller, and Herbert York were joined by Emil Konopinski, who told them of a cartoon by Alan Dunn which had aliens stealing the trash-cans. This led to a discussion of whether flying saucers could exceed the speed of light. After the conversation had turned to other matters, Fermi speculated aloud 'Where is everybody?', referring to alien visitors. He made some quick calculations, and concluded that we should have been visited by aliens already.

He argued that if the Earth is not special in having intelligent life, then civilizations should already have evolved many times in the Galaxy, since there are billions of stars older than the Sun. If any one of these civilizations wanted to colonize the Galaxy, they could have done so by now, even using technology that is almost within humanity's grasp. So where is everybody?

As Webb further points out, Fermi was not the only one to raise this question. Konstantin Tsiolkovsky in the 1930s, and in the 1970s David Viewing and Michael Hart, had also engaged with this puzzle (Lytkin *et al*., 1995; Viewing, 1975; Hart, 1975).

If there is no compelling evidence that any aliens have visited the Earth, then we must conclude that we are alone in the Galaxy. This is a

powerful argument. The emergence of humanity in terms of the age of the Universe is really quite late. If the age of the Universe were to be represented by the whole of the *Encyclopaedia Britannia*, then we would appear in the last sentence in the last paragraph on the last page! If other life were plentiful in the Universe, then we would expect it to have developed before the emergence of intelligent life on planet Earth. One can then calculate how long it would take an intelligent civilization to colonize the Milky Way galaxy. The answer is such that if another intelligent civilization were there, it would already be in our neck of the woods.

Of course, there are those who would object immediately to the statement that there is no compelling evidence that aliens have visited the Earth. We shall come to that. But let us for the moment just look at the question of space travel in a little more detail.

How might such galactic colonization be achieved? As we have already seen, to send human beings on board a spaceship would be very difficult. The energy costs alone in order to maintain an environment on board would be very high. In addition, there is the problem of the vast time-scales for such a journey. One person might make it to the nearest stars, but further afield, generations would have to be born and raised on the journey. The other alternative—a favourite of science fiction—is to deep-freeze human beings and wake them when they arrive. This would reduce the energy needed during the journey, but quite whether it is scientifically possible is still a very open question. Of course, while in deep freeze you could be eaten by aliens, switched off by mad scientists, or drift for ever because your guidance computer has a bug!

An alternative method for galactic colonization would be to send machines rather than people. This takes two forms. The first is to send a spaceship, containing on board human fertilized eggs or (if it were possible)—the building blocks and instructions on how to genetically create humans. When the spaceship finds an appropriate planet, new humans could be 'born' and 'raised' by the ship's computers and robots.

The second is simply to dispense with humans. While there has been considerable debate as to whether robotic space exploration is better scientifically than human exploration (Clements, 2009; Rees, 2011; Crawford, 2012a), colonization over such vast distances and over such vast time-scales seems to point towards the robotic option. This would involve sending space-probes that could collect and send back data, while being able to make new space-probes when they encounter the right raw elements in planetary systems. This

concept is called a von Neumann probe, after the scientist who suggested that it was possible (Von Neumann and Burks, 1966). It is a self-replicating universal constructor with intelligence comparable to the human level. It would be instructed to conduct scientific research and transmit back the results, while at the same time to search out construction materials to make several copies of itself. These copies would be sent on to other star systems. It is generally thought that such a machine could be developed within a century. When combined with better rocket technology, which is feasible, such machines could perhaps travel at up to one tenth the speed of light.

The astrophysicist Frank Tipler, one of the strongest advocates of the space-travel argument, has suggested that the island-hopping of the South Sea Islanders across the Pacific Ocean is a good model of this happening. They would arrive at an island and establish a colony. After spending some time there to allow the population to grow, a new expedition was sent to another island, and so the process continued.

In a similar way, 'planet-hopping' is limited only by the time it takes to travel from one to another, plus the time spent on a planet to get going to another. Now, the speed of light takes you across the Milky Way galaxy in 100,000 years, and the time needed on a planet to prepare for the next step is much shorter than this. Of course, it is difficult to believe that you could colonize at the speed of light, and so putting in reasonable assumptions, Tipler estimated that an extraterrestrial intelligence could explore or colonize the Galaxy in less than 300 million years, and could even be only 1 million years (Tipler, 1980; Barrow and Tipler, 1986: 576). This seems a long time, but in fact compared to the age of the Galaxy, which is not less than 10 billion years, is very short. So the time taken to colonise a galaxy, means that if intelligent civilisations are arising frequently in the Galaxy, we should have seen them already.

Some have argued against Tipler's calculations. Tipler assumes what is called a 'free expansion model' where essentially all the probes are sent to new stars. Sagan and Newman (Sagan and Newman, 1983) apply a 'diffusion model' which takes into account forward and backward motion; that is, some probes may be launched to systems where there are already probes. In addition, they took into account a suggestion of Jones that galactic colonization would be driven by population growth (Jones, 1995). Assuming zero population growth, Sagan and Newman extended the colonization time towards the age of the Galaxy. However, they have been rightly criticized for this assumption, and also for not taking into account a number of other factors (Webb, 2002: 74). Recent reviews of this question place colonization time between 1 million and 500 million years (Crawford, 2000).

Thus even with the longest possible estimate of the colonization time, aliens should be in our neck of the woods.

Therefore, the argument concludes that the absence of any extraterrestrial intelligence in our Solar System means that such space-travelling aliens apparently do not exist and have never existed in our Galaxy. The writer David Brin thus called the paradox 'the great silence' (Brin, 1983).

## 7.2 They Exist but They are Not Here or Have Not Called

The Fermi paradox appears at first glance to be compelling, but it is not without problems or challenges. Of course, there are those who would object immediately to the statement that there is no compelling evidence that aliens have visited the Earth. Others will argue that some factor makes galactic colonization extremely unlikely.

In a very carefully written analysis of the paradox, Webb offers fifty different counter-arguments, categorized in three classes (Webb, 2002). First, the arguments that say that extraterrestrials are here, such as there is evidence but it is covered up, we are descended from aliens, or that the aliens see the Earth as a zoo and do not want to meddle in human affairs. Second, the arguments that extraterrestrials exist but have not yet communicated because they are too far away, that SETI has been searching in the wrong places, and that aliens have no desire to communicate. Third, the arguments that they do not exist because intelligence is rare in the Universe or that the Galaxy is a dangerous place.

Webb concludes that the best option may be that we are alone as intelligent life in the Galaxy. There is no need to redo the arguments so well presented by Webb. However, it is interesting to this present study to look at a number of these arguments, as they play into, or have been influenced by, religious thinking.

### *7.2.1 ET, stay home*

Paul Davies questions whether it is feasible to build a von Neumann probe over such a time-scale, and also whether it would be economically viable. He then goes on to ask whether an alien race would launch such a programme of galactic colonization. Indeed, though we might talk of doing such a thing, economic constraints, as highlighted by the experience of NASA, mean that we have only briefly surveyed the planets in our own Solar System. Furthermore, at the moment we take the view that if aliens

are there, then they will contact us. An extraterrestrial intelligence may be thinking the same!

Sagan and Newman suggest that it is almost impossible to know whether extraterrestrial intelligence would or would not be motivated for colonization. We cannot presume that social structures, ethics, and aspects of culture would be similar to ours.

Barrow and Tipler are not convinced by such claims. They counter with the following:

1. If a civilization was trying to use radio contact then there is no reason why space colonization should not be seen as a better way of contact. There are many advantages, and so if you argue against colonization, you argue against any contact at all. They are there, but they are so silent that you cannot know that they are there.
2. The behaviour pattern not just of human beings but of all other living things on our planet suggests that expansion into new environments or colonization is basic to life, never mind intelligent life.
3. By colonizing the stars, a civilization increases the probability that it will escape the death of its own star when the star's available hydrogen fuel is depleted.
4. Any fear of von Neumann probes getting out of control is unlikely.

This is strong group of arguments. It does seem that physically exploring the galaxy is a much more productive and cost-effective way to contact other civilizations than simply using beams of electromagnetic radiation (Bracewell, 1960; C. Rose *et al.*, 2004; Sullivan, 2004).

Of course, one may then say that alien civilizations are not interested in exploring the Universe at all. They may be quite happy to stay at home and not look beyond their atmosphere.

We are here in the midst of the almost impossible task of understanding alien psychology, sociology, and politics. However, Christian theology would make a small contribution to this question. If God is the Creator of the whole of the Universe, and as part of creation gives science as a gift, then it would be a surprise for an alien civilization not to explore the Universe. Curiosity does seem to be a very important part of intelligence.

### *7.2.2 The zoo hypothesis*

In 1966 the General Assembly of the United Nations adopted the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. It recognized

the freedom of scientific investigation in outer space and the promotion of international cooperation in such investigation. It also recognized that astronauts shall be regarded as the envoys of mankind; and that all exploration should avoid harmful contamination of space and celestial bodies. Thus an ethical dimension was brought into space exploration.

One response to the Fermi paradox is to suggest that aliens are here but have reasons for remaining hidden, fearful of either contaminating the Earth or being contaminated by it. Tsiolkovsky, who was one of the first to point out the Fermi paradox, suggested that advanced alien civilizations would consider human beings as not yet ready for visitation, and would allow us to evolve first to a state of perfection.

Perhaps we are being watched and studied without knowing anything about it. This is the so-called 'zoo hypothesis' (Ball, 1973). Sagan was also sympathetic to this kind of response to the Fermi paradox. He commented:

> *The vast distances that separate the stars are providential. Beings and worlds are quarantined from one another. The quarantine is lifted only for those with sufficient self-knowledge and judgement to have safely travelled from star to star. (Sagan, 1995b: 398)*

It could well be that an advanced civilization would have the technology to maintain the 'zoo' until all parties are ready for contact. The trouble, however, concerns whether it is really possible to keep such a secret. The prime directive of *Star Trek* is to not interfere with the development of other lifeforms, but how many times has Captain Kirk been able to avoid a few photon torpedoes or some mid-1960s American moralizing?

Why would an alien civilization want to keep us in the dark? Noting the differences between technological levels, we would surely not be a threat to them. We might also add the possibility of an accident, which has often been the stumbling block to top secret technologies on the Earth. Furthermore, would a galaxy-wide civilization be able to police all its own beings? Perhaps a message would be sent by a group who believed that contact with the Earth was important—an alien leak! The zoo hypothesis does not seem to be totally convincing.

It also makes an important and difficult-to-defend assumption. As Webb puts it: 'To explain the paradox requires all civilizations to behave that way' (Webb, 2002: 115). This is a problem with all attempted solutions of the Fermi paradox. Not only do we have to suggest motive of ETI, but we then have to assume that all ETIs are alike in sharing these motives.

Christian theology would affirm the ethical dimension which cautions against the danger of contamination. The twentieth century was a time

when Christian theologians saw afresh the importance of care for the non-human environment as a gift from God, recognizing past theological mistakes which had seen the natural environment as only having value in serving human beings. In a much-quoted paper, the historian Lynn White argued that our ability to harness natural resources was marred by the deep rooted assumption that:

> *… we are superior to nature, contemptuous of it, willing to use it for our slightest whim… We shall continue to have a worsening ecological crisis until we reject the Christian axiom that nature has no reason for existence but to serve man… Both our present science and our present technology are so tinctured with orthodox Christian arrogance towards nature that no solution for our ecological crisis can be expected from them alone. (White, 1967: 1203)*

Thus, in his view Christianity bears 'a huge burden of guilt' for the environmental crisis. Yet Christian theology has responded to his call for a 'refocused Christianity' able to put ecology at centre stage (Berry, 2003). It has re-examined its doctrine of creation and spurred a great deal of activism in caring for the environment.

At the same time, Christian theology has also had to look honestly at the strengths and weaknesses of the missionary expansion of the nineteenth and twentieth centuries. The export of British colonialism which led to the destruction of indigenous culture was a grave error (Maul, 2007; Darch, 2009; Leigh, 2011; Stuart, 2011). However, at the same time, the missionary movement led to initiatives in health-care and education, and gave back to the West a number of areas of new understanding about the nature of culture and the world.

The Christian churches have not retreated completely from these areas because of past mistakes. One option would have been to oppose scientific and technological development in order to care for nature. Yet Christian theology wants to hold both a sense of progress alongside ethical responsibility. Likewise, to withdraw completely from mission because of past mistakes has not been generally accepted. Rather, mission has been reformed and rethought in the light of experience. Why? Because, exploration of the world is seen to be a gift from God, and a discovery of the richness of God's image in others is part of being human. Furthermore, helping others come to a fullness of the life of God in healing, learning, and in spiritual experience is part of the Christian calling.

Again the Christian understanding would seek to suggest that it is part of the nature of intelligence created by God to continue to reach out to

other intelligent life in compassion and generosity. The zoo hypothesis seems to go against this.

### *7.2.3 Aliens as gods*

Webb interestingly puts within the class of arguments that aliens are here an argument which he entitles 'God exists' (Webb, 2002: 55–9). Touching on whether alien encounter could be interpreted and retold in religious language (a point to which we will return to later), he goes on to discuss the possibility that there may be many other universes which are conducive to intelligent life, and a speculative suggestion that this Universe was created by alien species from another universe. In answer to the question 'Where is everybody?', one rather speculative suggestion is that they are in another universe.

It is interesting here that such a careful commentator as Webb gets drawn into theological questions which somehow arise in discussions not only about SETI but also the fine-tuning of the Universe and theories of multi-universes. As we saw in Chapter 3, the 'Goldilocks enigma' notes the surprising nature of the fine-tuning of the physical constants in the laws of nature. There are a number of responses to such an observation.

Stephen Hawking with Leonard Mlodinow extended his earlier work in his recent book *The Grand Design.* Hawking begins with his conviction that 'philosophy is dead. Philosophy has not kept up with modern developments in science, particularly physics' (Hawking and Mlodinow, 2010: 5). Following his trajectory in *A Brief History of Time* he attempts to use the laws of physics to explain not just the evolution of the Universe but also its initial conditions. In order to do this you have to bring quantum theory and General Relativity together into a quantum theory of gravity. Hawking believes that the best candidate to do this is M-theory, which is in fact a whole family of different theories in which each theory applies to phenomena within a certain range. It suggests eleven dimensions of spacetime. However, for Hawking it also suggests that our Universe is one in $10^{500}$ universes which arise naturally from physical law; that is, 'their creation does not require the intervention of some supernatural being or god' (Hawking and Mlodinow, 2010: 8). While welcoming Hawking's attempt to explain scientifically the first moment of the Universe's history, I have argued elsewhere that this simply and rightly demolishes a god of the gaps or a deistic creator, which is a long way from Christian theism (Wilkinson, 2001). The God of Christian theology is not a God who fills in any gaps of current scientific ignorance, nor interacts with the very first moment of the

Universe's history and then retires to a safe distance. Hawking's use of M-theory may eventually work, but the Christian theologian, while applauding enthusiastically, will also raise the question of where M-theory itself comes from. God is the one who creates and sustains the laws of physics, which science assumes but does not explain.

A different approach has been taken by others to the discussion of the fine-tuning of the Universe. Some have suggested that matter collapsing into a singularity at the centre of a black hole could be shunted sideways to create a new universe connected to us by a wormhole. Even on a conservative estimate of the number of black holes, this would mean that our Universe is connected to billions of other universes. Some physicists suggest that if these baby universes join back to our Universe by wormholes, then the values of the physical constants would be unpredictable. They would depend on the number of baby universes, which we are unable to specify. Other physicists take a very different view. They suggest that the leakage of information through wormholes actually fixes the constants to only one possible set of values (Davies *et al*., 2002; Carlip and Vaidya, 2003).

Lee Smolin sees a completely different consequence for black holes giving birth to baby universes (Smolin, 1997). He attempts to explain the fine-tuning of the Universe by integrating the theme of natural selection into cosmology. He suggests the following. A universe comes into existence, then collapses, bounces, and produces a 'new' universe. At each bounce, the values of the physical constants are changed slightly. This process is repeated until the constants have changed enough for the new universe to live long enough to produce numerous black holes. At this stage the singularity of each black hole gives birth to new universes. In this process, some universes are more successful than others. These are the ones that grow biggest and provide the right conditions for a large number of black holes, and consequently new baby universes. Out of this multitude of universes, one will be fit for life to exist. Our Universe, which is capable of supporting life, is 'selected'. This is analogous to the way by which biological natural selection eventually leads to human beings. Smolin's suggestion has many problems—not least the question of whether the model of evolution can be used outside the biological realm. Perhaps more importantly, there is no evidence that a black hole creates another universe.

Edward Harrison put forward an even more extraordinary reason for why the Universe is so finely balanced (Harrison, 1995). He says that there are three possible answers. First, that God designed it, though he argues that this answer precludes further rational inquiry. Second, the anthropic

principle, but he finds this unsatisfactory. His third answer is that our Universe was created by life of superior intelligence existing in another physical universe. How does he arrive at that conclusion? First, he picks up on the above suggestions of black holes as the birthplaces of new universes. Second, he argues that due to the rapid evolution of intelligence (which we currently see in humanity) there is every reason to expect that a time will come when we will be able to design and create our own universes. Thus, the fine tuning of this Universe is to be explained as an engineering project of superior beings. They have created this Universe out of a black hole. He calls it a 'natural creation theory', and claims that it also explains why the Universe is intelligible to us. It is created by minds similar to our own, who designed it to be that way.

There are so many questions to this that one hardly knows where to start. Will we really reach the stage of being able to build new universes? More fundamentally, where did these superior beings come from in the first place? He criticizes belief in God for stopping any further rational inquiry, but then falls into the same trap. What can we possibly know about these 'superior' beings in another universe? If he is to be drawn to the conclusion that this Universe is designed, is it not simpler to see the 'superior being' as God? Christians claim that this God, far from being in another universe, has revealed himself in this Universe and forms a personal relationship with those who open their lives to Him. The evidence for the existence of God is much stronger than that for superior beings in another universe.

To say that the theist states 'God created', and that this stops further inquiry, is naive in the extreme. It was on the basis of belief of a Creator God that much of the early scientific revolution was based. Far from stopping questions, belief in God can liberate inquiry.

Harrison's work is significant, for it is another example of the way that the fine tuning of the Universe raises deeper questions. However, one wonders just how contrived theories have to be to escape belief in God. It certainly does not convince as a solution to the Fermi paradox—that they are not here because they are in another universe as our creators.

### *7.2.4 The Doomsday argument*

One of the responses to the Fermi paradox is to say that civilizations are short-lived and will eventually become extinct. In this regard there is an interesting line of thought in the so-called 'Doomsday argument', developed independently by physicists Brandon Carter and Richard Gott (Carter, 1983: 347; Gott, 1993) and discussed by the philosopher John Leslie (Leslie, 1998).

The foundation of this is the application of a kind of Copernican principle to our position in time. The Copernican principle became powerful in reminding us that we did not have a special location in the Universe. In a similar way, Carter argued that we should not assume that we were living at a special time in the history of humanity. We would not expect our species to be alive in the first billionth of the human race that in the future was going to spread through its entire Galaxy. This suggests that humans will not survive for much longer, for if we were to do so then we would be living at an extraordinarily early epoch in human history.

It resonates with one of the strongest responses to Fermi's 'Where is everybody?' That is, civilizations are short-lived and do not survive long enough to colonize the Galaxy.

Yet is the Doomsday argument the best way to argue such a point? Leslie defends it strongly, saying that it

> *. . . acts very strongly only as a way of reducing confidence in a long future for humankind: confidence that such a future 'is as good as determined' . . . The most it could do would be to refute the view that its spreading across the galaxy was virtually certain. (Leslie, 2000: 122)*

It is an argument that depends on a number of questionable philosophical assumptions. In particular, what leads us to expect that being alive at an extraordinarily early epoch is unlikely? Such an assumption is reminiscent of part of the motivation of the Steady State model of the Universe proposed by Bondi, Hoyle, and Gold in the 1960s. Their motivation was to avoid ours being a special time, as well as other factors, including the influence of atheism (Kragh, 1996). If there was a beginning to the Universe, then by implication, not all times would be the same. Their 'Perfect Cosmological Principle' stated that the laws and properties of the Universe should appear the same to all observers at all times. They accepted that the Universe is expanding, but argued that this phenomenon can be better understood in a Steady State model of the Universe, in which there is no beginning but where matter is continuously being created throughout space. Yet observation proved them wrong. There was a beginning to the Universe, and therefore our observation of the Universe did change with time. There is no reason to believe that we should be living at a non-special time in the history of human beings.

The theist sees time in a very different way. Christian theology understands the unfolding history of the Universe as creation, where human beings have a special though non-exclusive place within it. In addition, time is given significance by God's acts within the Universe.

It is certainly the case that civilizations have the potential to destroy themselves through nuclear holocaust, genetic disasters, or environmental degradation. However, vulnerability to such events is lessened by the very galactic colonization that Fermi was considering. Once again, this kind of argument seems to project one pattern onto all ETIs. Maybe some do not make it to the colonization stage, but it is a very big jump to say that all do not make it to the colonization stage.

## 7.3 Visited Planet?

The Fermi paradox works, of course, only if there is no evidence of aliens in the Solar System. In discussion, the Hungarian physicist Leo Szilard replied to his friend Fermi's question 'Where is everybody?' with simply: 'They are among us, and are known as Hungarians'!

There are increasing numbers in the world today who argue that aliens are among us, and a plethora of popular books to promote the idea (Bringle, 2012; Halls and Spears, 2012; Harrison, 2012; Hawkins, 2012). Much of the mainstream scientific community disregards talk of UFOs, alien abductions, and direct contact. Rarely in the discussion of the Fermi paradox is space given to the claim that we are a visited planet. It is certainly an area fraught with difficulty, featuring conspiracy theories, unexplained phenomena, bad science, hoaxes, and flimsy evidence. Yet it is an area which cannot be ignored. Such claims need to be investigated, even if answers may prove elusive.

In 1947, Kenneth Arnold coined the phrase 'flying saucer' after seeing an object in the skies over Washington State. He was flying over the Cascade Mountains, looking to pick up the $5,000 reward which the government had offered for sighting a crashed transport plane. He saw nine disk-shaped objects travelling at incredible speed. He said to reporters that they moved like 'a saucer skipping over water'. A reporter suggested 'a flying saucer', and the name stuck (Arnold, 1950). The sightings went on. Within a month, the Air Force had received 850 UFO reports. Fuelled by movies, and in the early days in America by MacCarthyite paranoia and Cold War fears, people were looking at the skies and seeing strange objects (Clary, 2000). It was not as if this belief in aliens visiting the planet was something totally new. Between 1945 and 1947, Raymond Palmer of the US science fiction magazine *Amazing Stories* had boosted his circulation to 250,000 with stories presented as fact about space aliens. Interestingly enough for what was to happen later, these aliens also kidnapped humans.

By the late 1950s, tales of meeting with, and being abducted by aliens began (Brown, 2007). In 1997 a CNN/*Time* poll of Americans suggested:

- 25% said they had seen or known someone who had seen a UFO.
- 54% believe intelligent life exists outside Earth.
- 64% said that aliens had contacted humans.
- 50% said that aliens had abducted humans.
- 37% said that aliens had contacted the US government.
- 80% think the government is hiding knowledge of the existence of extra-terrestrial life-forms.
- 60% said they believed that a UFO crash-landed in a field outside Roswell, New Mexico.

The poll of more than 1,000 people has a margin of error of plus or minus 3 percentage points (CNN, 1997).

Such small-scale polls appear at regular intervals, often coupled with new media documentaries about aliens and other unusual phenomena. However, it is clear that a large number of people claim sightings of UFOs. Many of these claimed sightings can often be explained easily. Even those who believe in the existence of alien spacecraft acknowledge that at least 95% of UFO sightings have Earth bound causes—in terms of airships, aircraft lights, meteors, satellites, searchlights, flocks of birds, and laser light-shows at rock concerts. One also needs to take very seriously the existence of hoaxes.

The bright planet Venus is probably the most frequently seen 'UFO'. As time goes on, more and more people are unused to seeing natural phenomena in the sky. This is in large part due to the effect of street-lighting and other illumination, which blots out much of the night sky. As this trend increases, other natural phenomena such as Venus can be easily mistaken for UFOs. Sometimes the reported sightings are blown out of all proportion by their use to justify that UFOs are spaceships.

There are reported incidents where strange lights or objects are sometimes accompanied by radar traces. These are more puzzling. Of course, technology, which is very much human-produced, can also be mistaken for alien craft. In December 1978 a Soviet booster rocket entered the atmosphere over Europe. This led to a spate of reliable witnesses claiming to have seen a UFO about to crash with light coming out of portholes. The American stealth bomber was often mistaken for a UFO before its existence was acknowledged, and it is reasonable to suppose that other secret projects may be mistaken for aliens. This may explain why a number of sightings cluster around military bases.

However, it is realistic to acknowledge that some sightings remain unexplained. There is no immediate answer to a few reports given by people from all walks of life.

It would be very much easier if the spacecraft were as large and as public as they are in the movie *Independence Day*, where huge flying saucers position themselves conveniently over the major cities of the world. An incredulous child gazing at these objects cries, 'it's just unreal!' Indeed it is. Alien craft seem to come in all shapes and sizes and choose to reveal themselves in very odd places. They seem to have an elusiveness which is both attractive and frustrating.

The Roswell incident typifies the often widespread belief in government cover-ups. This has been a major theme of the *The X-Files*, and arises in relation to the Roswell incident in *Independence Day.* This follows the claim that the spaceship which crashed at Roswell in 1947 has been stored ever since in a vault beneath Area 51, a secret Pentagon facility within the Nellis nuclear test range. Despite official reports (United States Department of the Air Force, 1995), each year sees new claims (Saler *et al*., 1997; Frazier *et al*., 1997; Clary, 2000; Carey *et al*., 2009). These conspiracy theories paint pictures of secret documents detained in underground vaults, government departments involved in covert UFO research, and special departments which monitor military personnel in case of leaks of these top-secret documents.

Apart from the lack of hard evidence to support these claims, the immediate question is: why should the US government do this? The theme of a deal between the government and aliens is a very popular one. Often cited is an agreement that allowed the US military access to alien technology in return for aliens abducting humans. The reply to this is: where is such technology? Where is the US military using antigravity or phasers or warp drive? And why would aliens need to seek government approval to abduct humans? Surely they would be capable of just doing it!

Why would a government want to conceal the existence of aliens, and why would aliens, if they were here, want to keep their existence secret? Surely such a journey across the vastness of space would mean that they would want a state welcome! At this point, people suggest the zoo hypothesis. But this does not work. If you believe that there are aliens around from the stories and observations of UFOs, this then means that the aliens are not very good at keeping their existence hidden!

Much of this government conspiracy feeling does come from a distrust of government power and secrecy. It is not beyond the track record of most governments in the world to use secrecy to develop technical advantage. Nor is it beyond them to use the 'alien' story to cover up other military secrets. However, secrets have a habit of coming out. The evidence at present is not convincing that there is anything more than governments perhaps keeping an open mind on certain unexplained phenomena.

In 1966, John G. Fuller published a book entitled *The Interrupted Journey* (Fuller, 1966). It was a sensation. It told the story of Betty and Barney Hill who believed that they had been abducted in New England and medically examined by aliens. The book encouraged a flood of abduction stories in America, and then, indeed, world-wide.

Up to this point, those who had seen aliens produced a wide range of descriptions:

> *About a fifth of the aliens were more or less human-like; just over a third were small bipeds with huge heads; just under a third were not seen because of some clothing or helmet. Five percent were hairy bipeds. The remaining 11 or so percent were a miscellaneous bunch of complete weirdoes. (Harpur, 1995)*

Abduction stories, however, started to describe aliens who were remarkably similar, and there were common features to what happened. Abductions usually involved humiliating examinations and even sex with aliens.

All those who were abducted spoke of the sense of its being very real, of it having a lasting impression, and of finding it difficult to talk publicly (Holden and French, 2002). The use of hypnotic regression was key to unlocking these memories of abduction, which seemed to be repressed and could be 'released' only with this technique. Hopkins interviewed many people under hypnosis and reported on it in his book *Intruders* (Hopkins, 1987). He announced that up to 3.7 million Americans had been abducted. This is some claim, especially as some have commented that this is more Americans than can do long division! Abduction books sell in their hundreds of thousands. Reports of different types of aliens and conspiracy theories abound. The common alien is the Grey, a figure about one metre tall with big black oval eyes. These are the aliens who agreed a treaty with Earth governments, allowing them to abduct humans in exchange for alien technology.

What is beyond doubt is that many people truly believe that they have been abducted by aliens. This, apparently, often happens while they are asleep, and some claim to have been abducted up to three times per month. Some speak of the physical side-effects that this causes, and there are further claims of alien implants being put into the body during an alien abduction. Are these things really happening? We need first of all to raise a question about the use of hypnosis to bring back memories. In this form of regression therapy, hypnosis reveals what the patient believes to be true, not objective truth itself. Furthermore, such techniques are highly controversial in themselves. How much can a person under hypnosis be influenced by the person asking the questions? (Bullard, 1995).

Why would aliens need so many humans anyway, and deal with so many at one time? On this scale of figures, being abducted by aliens is as likely as having a road traffic accident.

However, recently there have been some scientific studies. Most famously, John E. Mack, a Harvard Professor of Psychiatry, undertook an extensive study (Mack, 1995; Mack, 1999). He worked for three-and-a-half-years with more than a hundred people who claimed they were abductees. Of these, some seventy-six fulfilled what he called the 'abduction criteria'—the conscious recall, or recall with the help of hypnosis, of being taken by aliens to a strange craft and having no apparent mental condition which would account for the story. His conclusion was startling. He claimed that the abduction experiences were real. However, that was not all that he concluded. It is very interesting that he went on to criticize a materialist world-view. He suggests that we participate in a Universe or universes that are filled with intelligences from which we have cut ourselves off. As a result of this alienation, the world has become subject to differences between rich and poor, violence, and ecological destruction. He describes the alien abduction phenomenon as having changed him profoundly, and that it has the power to do the same to others. This is religious language. Indeed, Christians would use similar language in describing some aspects of an encounter with God. For the Christian it is an encounter with the risen Jesus Christ that makes a profound change and has the power to do the same for others. Is there something here of people trying to reach beyond what they perceive to be the dry, physical world of modern science and recognize the spiritual in life? There are a number of questions against Mack's work. We have already mentioned problems with hypnosis, and he was criticized by colleagues for the way he set about his interviews and surveys.

However, one is left with a number of options. There are, of course, many options to examine before concluding that we are being visited by aliens. One possibility is that they are a way of extracting these stories through hypnosis, or because the general culture of science fiction within the popular mainstream is causing spurious memory (Newman and Beumeister, 1996).

Another possibility, suggested by Sue Blackmore, is that those who believe that they have been abducted by aliens are suffering from a phenomenon called 'sleep paralysis' (Blackmore, 1994). She has gathered more than a hundred cases where she believes this to be the cause. The phenomenon occurs when a person is on the edge of sleep and lies semi-conscious and aware, but cannot move. Such paralysis normally occurs during dreaming, as a natural safety-belt to prevent us from acting out our

dreams. In this state, dreams can seem like reality. It fits in with many abductions happening during sleep or late at night, and the victims having a feeling of helplessness. The people really do feel that it happened, but in an objective sense there were no aliens.

Others have suggested that it is the mind which produces sightings of flying saucers. Michael Persinger has observed a correlation between flying saucer reports and Earth tremors (Persinger, 1979). He speculates that the movement of the Earth's tectonic plates could release electromagnetic pulses which could then stimulate images in the mind, based on images from popular culture, of alien craft, beings, communications, or creatures. During the 1980s he moved on to determine whether he could explain religious visions in the same way. He stimulated people's temporal lobes artificially with a weak magnetic field to see if he could induce a religious state (Persinger, 1987), and claimed that the field could produce the sensation of 'an ethereal presence in the room'. This was not widely accepted, with questions about the initial results and indeed whether the magnetic fields themselves were so weak that they could not affect the brain in any way (Aaen-Stockdale, 2012).

Finally, in *The Demon-Haunted World*, Carl Sagan pointed out that the alien abduction experience is remarkably similar to tales of demon abduction common throughout history:

> *. . . most of the central elements of the alien abduction account are present, including sexually obsessive non-humans who live in the sky, walk through walls, communicate telepathically, and perform breeding experiments on the human species. (Sagan, 1995a: 124)*

This is an interesting observation. There are those who will say that aliens are in fact demons. Others will say that deep psychological factors produce experiences and visions, and that the current mythology shaped by pop culture rather than the mediaeval stories of the churches, lead to the personification of these fears as aliens.

We are left with the conclusion that the evidence from UFOs and abductions is not strong enough to believe that they are here. It is the case that there are phenomena which seem to lie beyond our present ability to explain. However, to invoke aliens as a way of filling the gaps often raises more problems than it solves.

## 7.4 If They Existed They Would be Here: A Tentative Conclusion?

The big scientific questions come down to assessing the evidence and coming to a provisional conclusion. This is held while further observations and

testing of the conclusions are carried out. Such conclusions are tested against further data-gathering, whether they are elegant explanations, and whether they are fruitful in explaining other things in the natural world.

In the past few chapters we have assessed the evidence of the size and nature of the Universe, the observation of planets, the nature and origin of life, and past and current SETI results. We have also looked at a set of arguments around Fermi's space-travel argument.

We are still at a very early stage of SETI in our observations and our theoretical understandings of key concepts. This makes any tentative conclusions very tentative indeed, and gives the opportunity for wide divergence among scientists.

Yet I do think that the current status of scientific research points in one or two directions:

- First, the Fermi paradox seems to indicate that the Galaxy is not teeming with alien civilizations. I do not believe that the responses to the Fermi paradox work, whether the zoo hypothesis or that we are a visited planet. 'Where is everybody?' means that we are either currently alone as an intelligent civilization in our Galaxy or that civilizations are relatively few and quite late developers in the history of the Milky Way. This would receive support from those biologists who stress the unlikely evolution of intelligent life on other worlds.
- Second, this does not rule out ETI in other galaxies, where the vast distances that separate galaxies are so large that the Fermi paradox is not as strong. Indeed, there may be ETI in galaxies so far away or beyond the observable Universe that we may never know.
- Third, this does not rule out non-intelligent life within our Galaxy. Indeed, I think there is growing evidence which points to the likelihood that primitive life will be found.

In all of this, I want to stay open to new observations and insights. I want to do this as a scientist, but I also have theological reasons to continue to pursue SETI. Throughout our review of the science we have often touched on the question of the link between religious themes and aliens. It is to this that we turn next.

# 8
# The 'Myths' of SETI and Religion

The word 'myth' is used in two very distinct ways when it comes to discussing religion. The academic uses myth to describe great stories which express deep truths about the nature of God, the world, and human beings. In contrast, in the popular arena, myth means something that is untrue.

The whole relationship of SETI and religion has been the arena of myths, in both senses. SETI can become part of the overarching narratives of understanding who we are in the Universe, but it can also be used for some bizarre religious philosophy. This is not just the area of cults and pseudoscience; it has also been explored by some of the scientists at the forefront of SETI.

## 8.1 Evidence for Cosmic Design?

William Derham (1657–1735) was an Anglican clergyman with strong interests in the biological and astronomical world. His *Physico-Theology* (1713), *Astro-Theology* (1714), and *Christo-Theology* (1730) explored the design argument for the existence and nature of God. *Astro-Theology* is significant, as in the words of its subtitle it attempts to be 'A demonstration of the being and attributes of God, from a survey of the heavens'. It develops the design argument in the context of astronomy in contrast with the more dominant biological arguments.

This popular theistic argument, called the 'design argument', occurs in philosophy from the time of Anaxagoras, *c*.500 BC, onwards. It attempts to move from the orderly and apparently designed character of the world to a designer. The Reformation of the sixteenth century and the scientific revolution of the seventeenth and eighteenth centuries saw the flourishing of this design argument. Eminent scientists such as John Ray and Robert Boyle used it to demonstrate God's creative power, wisdom, and providence.

The popularity of the design argument continued in the eighteenth and nineteenth centuries in the Bridgewater Treatises and the work of William Paley, who used all three of Derham's works and gave us an enduring watch analogy:

> *In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone comes to be there: I might possibly answer, that, for anything I knew to the contrary, it had lain there for ever; nor would it, perhaps, be very easy to show the absurdity of this answer. But suppose I found a watch upon the ground, and it should be inquired how the watch happened to be in that place. I should hardly think of the answer I had given before—that, for anything I knew, the watch might always have been there. Yet why should not this answer serve for the watch as well as for the stone? (Paley, 2008: 318–9)*

The intricate and delicate organization of a watch is overwhelming evidence that it has been designed. He argued that the argument was not weakened if the person had never seen the watch before, if the watch did not work perfectly, nor if the watch had unknown features. One could still infer a designer. In the same way, he argued, the Universe resembles a watch in its organization, and therefore there must exist a cosmic designer who has arranged the world this way for a purpose.

It was Darwin's explanation of the apparent 'design' of the biological world through natural selection which heralded the death of the popular design argument in the nineteenth and twentieth centuries.

It has therefore been curious to see a recent re-emergence of this kind of argument in cosmology, though framed in terms of pointers to God rather than proofs of God (Wilkinson, 2008b). These pointers, which we have touched upon earlier, are:

- Anthropic balances in the laws and circumstances of the Universe.
- The elegance and intelligibility of the natural laws.
- Awe in response to the nature of the Universe.

At the forefront of these kinds of recent discussions has been Paul Davies in a series of books, playfully suggesting that science may be 'a surer path' to God than religion (Davies, 1982; Davies, 1983; Davies, 1992; Davies, 2006). Coupling this with his view that the laws of physics make this a biofriendly Universe which will bring forth intelligent life, he adds another pointer to a deeper story of the Universe:

> *If life is widespread in the Universe, it gives us more, not less, reason to believe in cosmic design. (Davies, 2000: 15)*

As we have seen in Chapter 5, Davies believes that there are as yet undiscovered principles of complexity, organization, and information flow consistent with the laws of physics but not reducible to them, and that these principles lead to life and indeed intelligent life.

Monod gave a bleak picture of the random nature of evolution by saying: 'Man at last knows that he is alone in the unfeeling immensity of the universe, out of which he has emerged only by chance' (Monod, 1972: 167). In contrast, Davies proposes:

> *If it turns out that life does emerge as an automatic and natural part of an ingeniously biofriendly universe, then atheism would seem less compelling and something like design more plausible. (Davies, 2000: 15)*

Might the success of SETI imply deeper biofriendly principles in the Universe, and might these be a reflection of intelligence behind the Universe?

I suggest that we need to be very cautious about this type of argument. First, 'undiscovered principles' need a lot more work before they can be used in metaphysical arguments. Second, the whole design argument has fundamental weaknesses. Both David Hume and Immanuel Kant pointed out the vulnerability of the argument to evil and disorder in the world and to the possibility of alternative hypotheses. Indeed, it was Darwin's natural selection, in providing an alternative explanation of design, which led to the demise of the argument. A biofriendly Universe does not necessarily prove the existence of an intelligent creator. Third, Hume rightly argued that even if a divine designer could be inferred validly, we would not be able to postulate a Christian God who is good, wise, and powerful. Kant also came to the conclusion that the design argument at most could lead only to a cosmic architect using existing material. This is illustrated very well by the kind of cosmic intelligence that Davies ends up with. Neglecting the possibility of historical revelation and religious experience as a possible source of knowledge, he suggests that there is no conflict between a Universe evolving according to the laws of physics but is nevertheless subject to intelligent control. It is from this basis that Davies suggests a 'natural God' who operates within the laws of nature, directing and controlling the evolution of the cosmos to produce intelligent life. This use of the design argument leads to a God who is not transcendent but is contained by the Universe and its laws. Davies' God is more of a 'demiurge'—a craftsman 'god', rather than the supreme creator being. Indeed, Sir Fred Hoyle also followed such a line in proposing an 'intelligent Universe' (Hoyle, 1983).

In contrast, Christian theology builds its knowledge of God on the possibility of revelation; that is, the Creator God has revealed knowledge of himself in subjective experience and in particular events in the spacetime history of the Universe. Central to Christian faith are the events of the life, death, and resurrection of Jesus of Nazareth. Indeed, when the writers of the New Testament came to preach the good news of Jesus, they saw in Jesus the source of all life and the Creator God himself walking the pages of history. So the prologue to the gospel of John begins:

> *In the beginning was the Word, and the Word was with God and the Word was God. He was with God in the beginning. Through him all things were made; without him nothing was made that has been made. In him was life, and that life was the light of all people. (John 1:1–3)*

John combines two strands of ancient thought about the Universe. First is the Hebrew idea of God creating by his word (for example, Genesis 1:3), which is God's personal word bringing new things into being. The second is the Greek idea of 'logos'—the word in the sense of the divine ordering principle or impersonal rationality behind the Universe. However, the way he combines them is startling. A mere eleven verses later he writes:

> *The Word became flesh and made his dwelling among us. We have seen his glory, the glory of the One and Only, who came from the Father, full of grace and truth…No-one has ever seen God; but God the One and Only…he has made him known. (John 1:14, 18)*

John, reflecting the belief of the early Church, was driven to the conclusion that here was the Creator God himself in Jesus. It is through Jesus that God reveals himself.

It is from this perspective that the pointers raised by science of anthropic balances, intelligibility, and awe can be employed. They do not need to be used to prove the existence of God, but become part of an overarching interpretation of the world as creation.

Therefore, the success of SETI will not be evidence of cosmic design. But discussion of God becoming a human being leads us to our second great myth in this area; that is, God is an alien.

## 8.2 God is an Alien

In our review of responses to the Fermi paradox, 'Where is everybody?', we explored the claim that some have made that aliens are creators of the Universe—a term used traditionally for divine beings. Much closer to home

is the claim that religion is not the history of God's interaction with humans, but the history and response to alien visitors. The film director Stanley Kubrick once claimed, in connection with the making of *2001: A Space Odyssey*:

> *All the standard attributes assigned to God in our history could equally well be the characteristics of biological entities who billions of years ago were at a stage of development similar to man's own and developed into something as remote from man as man is remote from the primordial ooze from which he first emerged. (Agel, 1970: 331–2)*

Does the biblical record describe the visits of aliens? In many books connected with questions of extraterrestrial intelligence, such claims are made that, for example, the pillars of fire and cloud that led Moses to the promised land were in fact alien spacecraft or alien effects.

Even so, such a careful and brilliant a popularizer as Paul Davies writes:

> *Indeed, it is easy to trace reports of flying craft and human-like occupants back into antiquity, where the reports merge with religion or superstition in a seamless manner. Consider, for example, the many Bible stories of angels coming from the sky, of humans ascending into heaven (the sky), or flying chariots. The most striking biblical account is perhaps that of Ezekiel, who describes an encounter with four flying wheel-shaped craft 'full of eyes' that 'turned as they went', and 'out of which stepped the likeness of a man'. The account may have been taken straight from a modern UFO report. (Davies, 1995: 87)*

In fact, this kind of interpretation goes back to 1974, in a book entitled *The Spaceships of Ezekiel*, written by NASA engineer J. F. Blumrich (Blumrich, 1974). Comparison of the Blumrich argument with the actual text of Ezekiel shows many misunderstandings of both the context and literary nature of the biblical account.

Ezekiel chapter 1, in which claims of a spaceship have been read in, is described not in terms of an historical narrative but as a 'vision' when 'the hand of the Lord was upon' the prophet (Ezekiel 1:1). Similar experiences of seeing the things of God are described in Ezekiel's own vision of a valley of dry bones (Ezekiel 37), and in other prophets such as Isaiah (Isaiah 6) and Daniel (Daniel 10). In none of these cases does anything like a spaceship appear. What the writer of Ezekiel believes he sees is clearly a chariot-throne rather than a spaceship (Ezekiel 1:26). Contrary to Davies, the vision does not describe 'four flying wheel-shaped craft' but a rather

complicated arrangement of living creatures and four wheels on which the chariot stands (Ezekiel 1:15–21). It seems that each wheel consisted of two wheels, bisecting each other at right angles, thus allowing movement in any direction, though how they were attached to the chariot is an interesting engineering question! Furthermore, these wheels were not flying, but rose and descended with the living creatures. Where the living creatures with four faces come into this UFO is always omitted! The phrase 'full of eyes' (which has been claimed to indicate some kind of portholes) is very difficult to translate or to understand what was originally meant (Ezekiel 1:18). It is not stated that they 'turned as they went', but in fact, quite the opposite. Finally, 'out of which stepped the likeness of a man' is somewhat misleading. The figure stays on the throne. And it was no mere humanoid that Ezekiel saw, as he qualifies the 'figure like that of a man' with 'the appearance of the likeness of the glory of the Lord' (Ezekiel 1:25–28).

By selecting some elements out of context, reading into the particular verses things you want to see, and by frankly manipulating the words of the text to suggest something that it is not, then it is possible to claim that this was an alien spacecraft. No attention is given to the rest of the passage and how it fits with the theory; nor is it questioned why, if this was such a stunning spacecraft, did no-one else see it? Ezekiel was in exile in Babylon when this happened, and we know from the records left by the Babylonians that they were fascinated with objects in the sky and were good astronomers.

In addition, no attention is paid to what the 'alien' asks Ezekiel to do. He is to be a prophet to the people, bringing God's word to their situation. The word was to those Israelites who were in exile in Babylon. Its content has little to do with cosmic philosophies but is about righteousness and sin, judgement and hope. Do these things really fit with an alien visitor?

This all shows the danger of plucking texts from ancient documents without care of context or content, often interpreted in a particular way. These interpretations are then repeated by author after author until they take on vast importance.

Such manipulation of the facts is shown in the most famous author to suggest that aliens have long been visiting the Earth: Erich von Däniken. In fact, Blumrich was heavily influenced by reading von Däniken. In 1968 von Däniken published *Chariots of the Gods*, which became a world-wide best-seller, selling 3.5 million copies within two years. He claimed that the Bible simply told the story of aliens who had visited our planet—or in other words, God was a collection of alien astronauts. He suggested that aliens started the human race as a biological experiment—an alien form of genetic

engineering. They came back in biblical times to lead Moses through the wilderness, and built an interplanetary spaceport in Peru. His books continue to be reprinted at regular intervals (Däniken, 1969; Däniken, 1975; Däniken, 1981; Däniken, 2010; Däniken, 2012; Däniken, 2013).

There are many authors who have debunked von Däniken's claims and shown the flimsy nature of the evidence he so confidently presents (Allan, 1975; Story, 1976). What he considers to be his best pieces of evidence turn out to have straightforward scientific explanations. However, his argument suffers from an obvious flaw: if we were created by aliens, then who created them? If the reply is that their civilization arose quite naturally, then why did ours not arise naturally too? It is a similar flaw to the explanation for fine-tuning proposed by Edward Harrison, which we reviewed in Chapter 7; that is, our Universe was created by a superior intelligence existing in another physical Universe. But is not the claim of Christian theology open to a similar charge? After all, the question is often posed: 'If God created the Universe then who created God?' It is a question that is used by Richard Dawkins as a central argument in *The God Delusion*. He is right to show that if a cause–effect argument is used to prove the existence of God, then the question of who created God naturally follows. However, Dawkins does not seem to understand that Christian theology is not based on such arguments. It is based primarily on the interpretation of the events of the life, death, and resurrection of Jesus of Nazareth.

Von Däniken never goes as far as to claim that Jesus was an astronaut. In his *Miracles of the Gods* (1974) he launches a sustained attack on the Roman Catholic Church, and seems to suggest that Jesus is not sufficiently important nor advanced to be an alien visitor. Nevertheless, he created a climate in which it was a natural step to believe that many of the accounts of Jesus were simply telling the story of a super-technological alien. It has led to oft-repeated claims such as the following:

- The virgin birth was artificial insemination by an alien.
- Angels in 'shining garments' are actually aliens in space-suits.
- Jesus saying 'In my Father's house are many rooms' can mean only that there are many inhabited worlds in the Universe.
- Miracles such as feeding 5,000 people with a few loaves and fish were accomplished by alien technology.
- Walking on water was due to an antigravity beam.
- Prayer was really using a communicator with the spacecraft.
- The resurrection was achieved by the advanced medical science of the aliens.
- The ascension was simply 'Beam me up, Scotty'!

At first impression these claims could be convincing, but they do not stand up to further scrutiny. In particular, we need to ask three questions. First, is the life and teaching of Jesus of Nazareth consistent with such claims? There is a quality to Jesus as a human being which is attractive not only to billions of Christians in the world today, but also to those outside the Christian faith. The gospel accounts of his life picture a man in an obscure part of the Roman Empire, who stood alongside the poor and the oppressed, healed the sick, and spoke the good news of God's forgiveness and love. At the same time, he spoke of God's judgement and the personal cost of being true to God's way. It was a life of self-giving, and a teaching that was firmly focused on God and His Kingdom, rather than on space travel or other civilizations. Yet alongside his self-giving was what to many appears to be rampant egomania. The gospels are quite clear that Jesus was not primarily instituting a new social structure or even a code of personal ethics; he was offering a personal invitation. To see God, you had to look at Jesus. He did not just teach about truth, life, light, and resurrection; he *was* those things. You found God's forgiveness through him, and the challenge was to follow him as a disciple. Some years ago, C. S. Lewis used a famous argument, as follows. In the light of the above, you had to decide between three options: Jesus was either mad, bad, or God. The depth and attractiveness of his life and moral teaching meant that to condemn him as insane or as a fraud was unconvincing, and so that left just one alternative.

Second, is the death of Jesus consistent with such claims? If Jesus was an alien visitor, his death makes no sense at all apart from the possibility that his mother ship could not arrive in time to save him. However, for the writers of the gospels the death of Jesus is not that it was a mistake, but that it was absolutely central to his mission. Christian theology understands the death of Jesus as a supreme demonstration of God's love, as God in Jesus offers us salvation from sin.

Third, is the resurrection of Jesus consistent with the claim that he was an alien? The gospels are quite clear that the resurrection of Jesus was not a simple resuscitation, as there was something different about the one whom they knew as Jesus. He seemed no longer to be restricted to the spatial and temporal constraints of the Universe, for example, being able to appear in rooms where the doors were locked. He promised his everlasting presence with the disciples, and after his ascension and the giving of the Spirit they knew with countless other Christians down the centuries his living presence in their lives.

Of course, in asking such questions I am invoking the gospel accounts of Jesus. Some will immediately rule this out as somehow less rigorous

than science. Theology is a discipline different from science, but its art of assessing evidence and models of God do have academic integrity. As someone with experience of work in both science and theology I am sometimes a little frustrated when theology as an academic discipline is written off. In the previous section I am not invoking 'the Bible says' as a way to close down the argument; I am simply pointing to questions of consistency and evidence in the understanding of Jesus. In this book, space does not allow a survey of the authenticity, historicity, limits, and complexity of the gospel narratives, but such work can be done (Wright, 2003; Dunn, 2010). It is certainly the case that no other body of literature has undergone such critical evaluation, and its historical reputation has stood up well.

However, Christianity does not rely solely on its historical basis. Common to Christians in all the different denominations in many different cultures of the world is the belief of a personal encounter with the risen Jesus. It is the continuity of this subjective experience with the historical basis that is the key test of Christian claims to truth. The neuroscientist Donald MacKay has written:

> *The basis of a Christian conviction of the truth of his faith is not that he has solved an intellectual riddle, but that he has come to know a living Person—the Person of Jesus Christ. It is his new relationship with God that makes the doctrine ring true, not the other way round. (MacKay, 1988: 17)*

This brief diversion into the evidence and nature of Christian faith also leads on to another important point. Christian theology does grapple with the motives of Jesus and indeed God in interpreting the evidence of both religious experience and historical events. We have seen on a number of occasions that SETI attempts to ask questions of the motives of aliens, such as in communication or space travel, with far less evidence. At one extreme are von Däniken and perhaps Harrison, who do not ask the question at all.

Nevertheless, von Däniken seeded so deeply the mythology of alien visitors as creators that it reappears often. Cowan, writing about the science fiction series *Stargate SG*-1, points out its dependency on von Däniken's ideas and states:

> *…the question is not how these various theories and hypotheses can be debunked, but why these myths of origin endure and, for our purposes, what that endurance in a long-running science fiction series like* Stargate SG-1 *can tell us. Put simply,* SG-1 *reinforces the transcendent value of cosmogonic myths. It highlights our collective need for myths of origin,*

> *and questions the ability of technology, of science, and of modernity and post-modernity to corrode the power of those myths. Indeed, in science fiction, these myths are often reimagined, reinvigorated, and replayed. (Cowan, 2010)*

SETI, in a way similar to science fiction, can provide myths which want to point beyond earthly existence to some form of deeper story to the Universe.

## 8.3 Contact Problems for Religion

Jill Tarter wants to go further in the way that SETI might shape mythology. She proposes that contact with extraterrestrial intelligence might eliminate religion as we know it, and introduce humanity to a new and all-encompassing faith.

Excited by the pioneering work of Drake, Cocconi, and Morrison, in 1971, Tarter, at the age of 27, committed her career to SETI after reading NASA's first major report on the subject. She comments: 'I realized I was part of the first generation that did not have to ask a priest the "Are we alone?" question' (Waldrop, 2011). She has become one of the leading SETI scientists in the world, and one of the driving forces behind the SETI Institute. She believes that it is likely that any contact with another civilization will be with an advanced civilization. As her colleague at the SETI Institute, Seth Shostak, puts it, our contact will be with 'societies with thousands or millions of years of technology under their communicator belts' (Shostak, 1998: 200).

For Tarter, the success of SETI will mean a moving on from the religions of this world. She argues that if ETI is detected then 'long-lived extraterrestrials either never had, or have outgrown, organized religion' (Cornell Tarter, 2000: 145), and identifies religion as one of the main reasons for the cause of war and the destabilization of societies. If, however, extraterrestrials have survived long enough to make contact with us or to traverse the distances of space, then they would have matured beyond the diversity and brutality of Earth's current religions. Thus, stable technological civilization implies either one universal religion or no belief in God at all.

Tarter also suggests that an advanced civilization, revealed by a greater level of technology, will have a more advanced religious faith. If they do have belief in God it will be so far in advance of our form of religion that we will convert to it:

> *The major religions of the world may be able to accommodate the idea of extraterrestrials into their current dogma, but some of them may be quite discomforted by the information revealed by the fact of extraterrestrial technologies. (Cornell Tarter, 2000: 148)*

Such a view of the advanced nature of ethical and religious belief in scientifically advanced civilizations is shared by a number of other SETI thinkers. Billingham suggests that an extremely advanced but benevolent extraterrestrial civilization might put an end to present-day religious conflicts and lead to greater religious toleration worldwide (Billingham, 2000: 33–9). Albert Harrison tells us what 'advanced' means when we speculate about ETI:

> *A fundamentally positive picture emerges when we extrapolate from life on Earth: there are trends toward democracies, the end of war, and the evolution of supranational systems that impose order on individual nation-states. This suggests that our newfound neighbors will be peaceful. (Harrison, 1997: 312)*

This type of argument is at the very least controversial, and at the most impossible to maintain. Both historians and sociologists will point to evidence which complicate the argument greatly. However, the line that Tarter follows is dependent on a number of key assumptions.

The first is what is often called the 'myth of human progress'. The twentieth century has been dominated by this myth—an overarching story in which human history is pictured as a march towards Utopia, a state of moral perfection both for the society and individual. At the turn of the century the triumph of physics, Darwinian evolution, and technological breakthroughs encouraged this confidence and optimism. The path to such a Utopia became identified with the power of human beings to change the world through science, technology, and education (Bauckham and Hart, 1999). Such a dream has not delivered; indeed, in many respects it became the nightmare of world wars and environmental destruction, but this sense of human progress still strongly informs many speculations about the future.

Peters goes further to suggest that the assumption of progress within evolution causes the expectation that an extraterrestrial civilization is more intelligent and more advanced than that on Earth. Such an extraterrestrial civilization will allegedly have an advanced science that can save Earth from its primitive and underevolved propensity for violence. He labels the constellation of scientific assumptions here the 'ETI myth', and shows clearly some of the weaknesses of these assumptions (Peters, 2009).

The second is what is often called the 'secularization thesis'. This kind of view is deeply embedded in Western views of progress. While Western culture owes a great deal to the Judaeo-Christian culture which enabled its growth in areas such as science, art, law, and education, one of its contemporary features is that it is increasingly adrift from, and indeed at times increasingly antagonistic to, its roots. This can be interpreted in terms of the thesis of secularization (Bruce, 2002; Bruce, 2011; Gorski, 2012); that is, the growth of science and technology undermines religious belief, relegates the Church to the margins of society, and leads to seeing Christian faith as a privatized interest. Yet the situation is more complex than a number of commentators are prepared to acknowledge. Some churches are growing, especially the Pentecostal and other churches outside traditional denominations; and even traditional churches have significant growth (Goodhew, 2012). The secularization thesis has also been challenged in its claim to present a universal model of how science and technology shape a culture and religious belief (Smith, 2003; Taylor, 2007; Warner, 2010; Martin, 2011; Firestone and Jacobs, 2012). The sociologist Grace Davie illustrates this by arguing that Europe is the exceptional case. The bluntness of the secularization thesis is that secularization is inevitable in any society which grows in science and technology; thus, what has happened in Europe will eventually happen in other parts of the world. Davie rightly points to different parts of the world to show that this is not the case. The United States remains highly religious, seeming to have no problem with religion and modernity. In Latin America the astonishing growth of Pentecostalism, and in Asia the growth of many religious groups in the midst of modernity, tells a very different story to Europe. South Korea, of course, has seen tremendous industrial and educational growth in the last 100 years, coupled with tremendous growth in not only the Christian Church but other religious groups (Davie, 2002). We may point further to the way that religion has survived and indeed flourished under Soviet and Chinese communism (Froese, 2008).

The third assumption is to make a strong link between religion and war. This seems to be on safer ground, with many war leaders claiming to have God on their side, from the Crusades to the Gulf Wars. Yet there may be more to this. In 2004 the BBC commissioned a 'War Audit' by Austin, Kranock, and Oommen—researchers at the Department of Peace Studies at Bradford University (Austin *et al*., 2004). It set out to explore the relationship between religion and war and to see whether there has been a rise in religiously motivated violence. Reviewing the current scholarship on these issues, they suggest that few wars were fought primarily because of

religious differences, with very few genuinely religious wars in the past century. Although armed conflicts may take on religious overtones, they are much more complex, involving factors such as ethnicity, nationalism, identity, power struggles, resources, inequality, and oppression. Indeed, atheistic totalitarian states, such as Stalin's Russia and Mao's China, have perpetrated more mass-murder than any state dominated by a religious faith.

Thus the projection of alien religion being more advanced because of more technologically advanced society is more complex than at first appears. It also suffers from a deeper assumption—that religious belief develops almost like philosophical knowledge. Paul Davies is very similar to Tarter when he claims:

> *God's progress and purposes will be far more advanced on some other planets than they are on Earth… it might be the case that aliens had discarded theology and religious practice long ago as primitive superstition and would rapidly convince us to do the same. Alternatively, if they retained a spiritual aspect to their existence, we would have to concede that it was likely to have developed to a degree far ahead of our own. If they practised anything remotely like a religion, we should surely soon wish to abandon our own and be converted to theirs. (Davies, 1996: 33–7)*

However, Davies adopts this view because he has little concept of revelation. He sees religion as intellectual progress, so that another society more intellectually advanced would be bound to have a higher religion. But Christianity's central claim is not a spiritual evolution which will take us closer and closer to God as our knowledge increases. It realistically acknowledges how finite our minds are in the face of the infinite, and is based on the fact that God reveals truth about himself in a way that we can understand. Now of course, as time goes on knowledge of God grows, but its foundation is God's particular revelation. Furthermore, it recognizes that our fundamental need is not a super-religion but a reconciliation which we cannot achieve for ourselves. God achieves it through a particular action in a particular place and moment of time. Biblical Christianity sees revelation and salvation inextricably linked in the life, death, and resurrection of Jesus of Nazareth. Not that all that can ever be known about God is here; just that it is a revelation which offers salvation and reconciliation.

Nevertheless, Tarter, Davies, and other writers are correct in thinking that an encounter with ETI would raise theological questions for the Christian faith. This may be challenging, but it also may be a learning experience. In the words of Zubek:

> *If we can understand that our way of encountering the universe and our views of spirituality only begin to express the range of ways that intelligent beings deal with Ultimate Reality, we are guaranteed to gain something very powerful: a more humble, more realistic, and yet paradoxically more complete and more extensive understanding of our own place in the universe. (Zubek, 1961: 393)*

This challenge may hold true even if we never actually make contact with life beyond Earth, but 'encounter' other forms of life only in hypothetical scenarios of our own construction.

# 9
# SETI and the Christian Understanding of Creation

In 1960 the astronomer Harlow Shapley wrote:

> *Will the now widely accepted hypothesis of highly developed sentient life throughout the stellar universe affect religious creeds? (Shapley, 1960: vii)*

We have seen that the 'wide' acceptance of the hypothesis has fluctuated over the past five decades, but from our survey of the scientific arguments, Mark Worthing is right to propose that the 'recent legitimation of the search for extraterrestrial life within the scientific community' calls for 'a rediscovery of the significance of this question within the theological community' (Worthing, 2002: 61).

In the next two chapters we shall see how SETI interacts with the doctrines of creation and redemption in Christian theology. Of course, there are many more parts of Christian belief, but these two doctrinal areas will give a good basis for further conversation.

## 9.1 A New View of God as Creator?

There are some who will claim that if SETI is successful and the Earth is shown not to be unique, then this would undermine the case for a miraculous origin and indeed God as Creator. It is difficult to see any strength in this argument. If the argument assumes that all Christians believe that the Universe is only a few thousand years old on the basis of reading the early chapters of Genesis as a scientific textbook, then it may have some force. First, however, such a reading of Genesis is a minority view among Christians both in history and today. From the early Church theologian Augustine and then onwards throughout Christian history, the early chapters of Genesis have not been read as literal scientific description, but as a

theological text, more interested in telling us who God is rather than the physics of the creation (Wilkinson, 2002). Second, even if God did create by six-day special creation, then there is no reason why he might not create somewhere else by miracle also. Third, and perhaps most importantly, those who hold a six-day creationist view will have more problems in dealing with contemporary science than SETI.

Then there are those who will claim that ETI is ruled out because other worlds are not mentioned in the Bible. This again is a very weak argument. The Bible does not mention explicitly the creation of cats and dogs, amoeba and armadillos, dodos and dinosaurs, and a host of many other aspects of the natural world. There is therefore sometimes a temptation to read back into the biblical accounts things that are not there in the original authorial intention—a temptation which we saw in Blumrich and von Däniken. But Christians have never viewed the Bible as a complete description of all things in creation; rather, they see it as a sufficient and effective description of God's relationship with the Universe. Worthing is right to say:

> *Christian theology has no biblical or theological basis upon which to reject out of hand the possibility of extraterrestrial life. (Worthing, 2002: 71)*

The Christian understanding of creation at its heart is about who God is, and then confidence in such a God. It is not presented in the Bible as a systematic and scientific discussion, but is contained in a diverse number of narratives and literary styles. As well as the much discussed Genesis 1–3, we might add Proverbs 8:22–36, Psalm 8, Psalm 19, Psalm 148, Genesis 9:8–17, Job 38:1–42:17, and Isaiah 40:9–31 as obvious examples in the Old Testament. Then there is the way that creation appears in the New Testament and in other biblical themes and narratives—in particular, the themes of sin, fall, and covenant.

The Bible does not discuss creation in terms of cosmology for its own sake. Creation is discussed for worship, encouragement, the challenge to holiness, and reassurance. Karl Barth reflected this very clearly in his own theological thinking about creation. He expressed it in terms of the covenant being the 'internal basis of creation' (its inner rationale) and of creation being the 'external basis of the covenant' (the context within which covenant could be initiated and brought to consummation). By so doing, he attempted to reorientate the discussion away from creation and cosmology to God's relationship with creation and humanity in particular.

Again it is beyond the scope of this book to discuss the whole of the doctrine of creation. I have attempted to do some of this alongside the work of many other scholars (Murray and Wilkinson, 2005; Wilkinson, 2008a;

Wilkinson, 2009a; Wilkinson, 2009b). Yet it would be worth drawing on a few themes which directly impact on the conversation with SETI.

### *9.1.1 God is sovereign in the creation of the Universe*

The first verse of the book of Genesis sets out a clear statement of the sovereignty of God in the creation of the spacetime Universe: 'In the beginning God created the heavens and the earth' (Genesis 1:1). It may be obvious to draw attention to this, but we should not underestimate its importance to the author of this understanding. God is not constrained by other gods, pre-existing matter, or human expectations. He is free in creating.

This is illustrated in a number of subtle ways in the Genesis 1 passage. For example, in verse 21 it says: 'God created the great sea monsters'. This special word for 'create' is used only in the creation of the heavens and the earth (Genesis 1:1), the creation of humanity (Genesis 1:27), and here in verse 21. We might understand why this word refers to the whole of creation and human beings, but why the great sea monsters? It seems that this is theological polemic. In some stories of the ancient Near East, God has to overcome the great creatures of the sea before creating. The polemic here is to say that even if these great sea creatures exist they are all created by the one God.

Of course, scholars debate the nature of polemic and how the author of Genesis 1 uses it. In 1895 Gunkel raised the question of whether Genesis 1 is dependent on other creation stories, and many theories have been suggested as to the relationship of the Genesis account to stories in the ancient Near East, such as the Babylonian creation stories *Enuma Elish* or the *Atrahasis* epic, or Egyptian ideas of creation in such works as *The Teaching of King Merikare*. Some have reduced the Genesis account to a much later work which has simply copied more ancient stories, while others wanting to defend the purity of Genesis as revelation direct from God have emphasized the differences. The truth is probably more complex than either of these standpoints (Lambert, 1965; Tsumura, 1989: 156–7). However, the intention of the author seems clear. The message conveyed by this text is that God is without peer or competitor; he has no rivals in creation. His word is supreme; that is, He speaks and it is done. This theme is picked up in other parts of the Scriptures. The book of Isaiah uses creation to ask 'Who is like God?' (Isaiah 40:18), the book of Job speaks of the mystery of God (Job 38:4), and various Psalms use it as an encouragement to worship.

The sense of God without peer or competitor in creation has led Christians to develop this into an understanding of God's creative work out of nothing. For some, the opening image of a primordial watery chaos over which God's spirit hovered and into which God's word was spoken, leaves open the question as to whether God simply shaped the Universe from pre-existing matter, somewhat like an architect imposing order on matter that was ready to hand. This view appeared in Gnostic writers, and was, in turn, used for apologetic purposes by Christian apologists such as Justin Martyr, who was executed in 165 AD. There have been some who have argued that 'creation out of nothing' is at best ambiguous in Genesis, and only came to clear articulation as Christian faith encountered and responded to the questions and challenges of Greek philosophy and Gnostic thought (May, 1994; Young, 1991). But such arguments underestimate the sense of God as sole Creator contained within the creation accounts of the Old Testament. Of course, the writer of Genesis 1 was much more concerned with proclaiming the movement from chaos to order than with speculating on the absolute origin of things. Nevertheless, it is important to be clear that for the biblical writers there was no significant dualism of God and matter/chaos. The emergence of the doctrine of *creatio ex nihilo* in Christian writers of the second and third centuries, such as Theophilus of Antioch, Irenaeus, and Tertullian, was driven precisely by the concern to maintain the biblical affirmations of the basic goodness of the world and of God's utterly unopposed freedom in creating. All that exists has its source in nothing other than God.

Torrance defines the doctrine as follows:

> *The creation of the Universe out of nothing does not mean the creation of the Universe out of something that is nothing, but out of nothing at all. It is not created out of anything—it came into being through the absolute fiat of God's word. (Torrance, 1996: 207)*

He argues, significantly, that this doctrine was important for the development of the natural sciences on account of the affirmation of the fundamental goodness of creation that it represents. Creation is distinct *from* God but dependent for its existence *on* God. As such, creation is both to be valued, rather than to be escaped, and free to be investigated rather than worshipped. Along with this, God was not constrained in creating by the limitations of pre-existing matter, but could create freely. Thus, to fully understand the God-given order of the Universe it was necessary to observe it; that is, one of the basic principles of empirical science.

God is free to create ETI. This was one of the grounds for the rejection of the Aristotelian view that the Earth was the centre and therefore alone in

the Universe. Furthermore, Christian theology says that the only way to know whether there is ETI is to continue to search for it; it cannot be derived from theoretical considerations alone. I suggest, therefore, that the Christian churches need to be active supporters of SETI. Of course, all big science comes with a financial cost, and that cost is weighed against other priorities for spending of government and charitable money in the world. So as with all science, SETI can never have a blank cheque, but has to find a place within all other funding considerations. As will be clear from Chapter 7, I may remain quite sceptical about the success of SETI on the basis of current scientific arguments, but my Christian theology leads me to be an active supporter of SETI programmes and research.

### *9.1.2 God is the source and sustainer of the universal laws*

If modern science depends on the biblical conviction that God as sole Creator of the Universe had freedom in creating, then it also needs a belief that this freedom does not lead to incomprehensible chaos in the Universe. As we have seen, many historians of science have pointed to the Judaeo-Christian worldview as giving the belief in an inherent order to the natural world, and that this order should be comprehensible. Thus the laws of physics are a reflection of the faithfulness of God in sustaining the Universe and its order.

This theme is communicated, for example, through the description of the role of Wisdom in creation (Proverbs 8:22–31). Wisdom is before the Universe and fundamental to its creation (vs23–29), and Wisdom's relation to the creation is given in terms of an architect (vs27–29), a builder (v28), and a ruler (v29). Wisdom is personified and fundamental to the whole creative process, and in particular to ensuring the stability and continuation of the creation. Wisdom is key to the continuous process of fashioning creation into a world which is intelligible, orderly, and good. The images of architect and builder give a picture of a well-structured creation. Further, Wisdom rules the chaos of the sea, setting boundaries for it. There is no suggestion of a primaeval battle between the waters and God, but simply that the chaos of this world is contained by Wisdom.

This sense of God freely creating the Universe in an orderly way not only encouraged the growth of science but also encouraged the belief in a plurality of worlds. The universality of the physical laws in all parts of the Universe present the possibility that we might find intelligent creatures with some common ground for communication. As a result of this, I am quite drawn to the group of arguments presented by Simon Conway Morris

and Paul Davies that the Universe is biofriendly and that evolutionary convergences mean that if there is intelligent life elsewhere in the Universe it will not be too dissimilar to us.

It is important to note that this emphasis on God as the source of the laws of nature should not be used to re-energize proofs for the existence of God. The reflection of God in the order of the Universe can be seen only in the dialogue of God's word and his works. None of the biblical accounts suggest that God can be found on the basis of rational argument. When the order of the Universe is discussed it is discussed in the context of a God who speaks and reveals his role as Creator of that order. For example, the heavens declaring the glory of God (Psalms 19:1) are held together with the law of the Lord 'enlightening the eyes' (Psalms 19:8). For the Christian, the New Testament takes this further and says that the Creator God is fully seen only in Jesus Christ.

### *9.1.3 God is an extravagant creator*

Alongside these images of lawgiver, king, builder, and architect, God is also the great artist in creation. If we return to Genesis 1 we see creativity and diversity in abundance. The earth was formless and empty (v2)—a phrase that could be translated as 'total chaos' or 'waste and void'. This formless earth could signify either nothingness or disorder. The word is often used in describing the experience of being lost in a desert without tracks or distinguishing features as guides (Job 6:18). It is into this monotony, disorder, and darkness that God brings differentiation, contrast, structure, and order. The acts of separation (vs3, 6, 7, 14, 18), as well as giving a sense of structure, also show God as giving diversity to the created order. We may at times not notice these differences, but contrasts add to our sense of beauty of the world. The contrasts of heat and cold, oceans and dry land, the brightness of a summer day, and the star-field of a clear night, affect all our senses and add to our experience of the world as an awe-inspiring place. Then into this structure comes light and life. Once again, here is diversity and creativity. When vegetation is brought forth it is of various kinds, with the ability to reproduce (v11).

One of the greatest understatements of the Scriptures is 'he also made the stars' (Genesis 1:16). It is an awe-inspiring by-the-way statement of the creativity of God. The question can be asked of those who believe in God, of why God made the Universe so large. After all, if God was interested only in human life, one planet orbiting one star would have been sufficient. Indeed, it might seem that a much slimmed-down natural world could have

also sustained human life. However, the Universe contains 100 billion stars in each of 100 billion galaxies, and the biological environment of the Earth teems with a rich diversity of life. At this point the biblical images of God flinging stars into space present a picture of a divine artist who loves diversity and extravagance in creation. Indeed, Psalm 148 uses this extravagance as a source of praise to the Creator. As Wenham comments on Genesis 1, here 'God the great artist is pictured admiring his handiwork' (Wenham, 1987: 38). God delights in the diversity of his creativity.

In fact, far from being a dry scientific or even theological text, this first chapter of Genesis breathes worship. There are indications that it reflects a liturgical form; that is, it was used in worship. It is liturgy or a meditation on the work of creation, so that we can understand that the creation is related to God. Its central concern is not to explain the how of creation, but to catch up the reader with the wonder of creation. This is not to exalt the creation itself, but as an invitation to worship the Creator. Creation is used to encourage worship, to increase faith, and to change perspective on our life in the light of the nature of God.

The Roman Catholic theologian and former president of the University of Notre Dame, Father Theodore M. Hesburgh, applies this theme to SETI:

> *It is precisely because I believe theologically that there is a being called God, and that He is infinite in intelligence, freedom, and power, that I cannot take it upon myself to limit what He might have done. Once He created the Big Bang…He could have envisioned it going in billions of directions as it evolved, including billions of life-forms and billions of kinds of intelligent beings…As a theologian, I would say that this proposed search for extra-terrestrial intelligence (SETI) is also a search of knowing and understanding God through His works, especially those works that most reflect Him. Finding others than ourselves would mean knowing Him better. (Drake and Sobel, 1994)*

Of course, some of this extravagance is needed to make possible carbon-based intelligent life. For example, the Universe has to be big enough and old enough to cook the carbon in stars that will eventually end up in our bodies. Livio argued that a calculation of the cosmic history of carbon production that is based on the recently determined history of the star-formation rate suggests that the most likely time for intelligent civilizations to emerge in the Universe was when the Universe was already older than about 10 billion years (Livio, 1999). Yet this extravagance also seems to be just part of the process of creativity, and not necessarily there only in order to bring about human beings.

Thus the Christian theologian is both relaxed about and expects the discovery of further diversity in the Universe. The confirmation of multiverses or primitive life in many different and exotic places in the Universe would add to the already known richness of the natural world and reflect even more on God's extravagance in creation.

The Oxford cosmologist E. A. Milne wrote:

> *Is it irreverent to suggest that an infinite God could scarcely find the opportunities to enjoy himself, to exercise His godhead, if a single planet were the seat of His activities? (Milne, 1952: 152)*

Recognizing that this diversity is God-given means that it is to be respected and cared for as a gift. The biblical accounts of creation taken together critique an arrogance which sees human beings as the centre and exploiter of the rest of creation. It is striking that the Genesis 1 narrative reaches fulfilment not in the creation of Adam and Eve but in the Sabbath day on which 'the whole creation glorifies its maker' (Fergusson, 1998: 17). This provides a perspective on the distinctive role of humans within the created order as that of priests giving voice to creation's praise. That is, resting in, rejoicing in, and living out of the Sabbath praise of God is regarded here as the very pinnacle of what created reality, and human reality in particular, is called to. Viewed in this way, we humans are called not just to 'use' material reality for our own ends, but to hallow it, to reverence it as God's gift, to work for its flourishing, and, in this manner, to be viceroys of God's gracious generative sovereignty in God's good world.

This combination of the complex and extravagant diversity within creation with the essential role of human beings does make clear the risk involved in creation. Here the biblical accounts make very clear the effect of human sin upon the land, while at the same time holding out the hope that the God who created this Universe will not stand apart from it, but one day will bring about new creation (Isaiah 65:17–25). It is this combination of risk and hope that motivates and encourages human beings to join with God's purposes in the care and renewal of creation.

Christian theology will therefore want to push the ethical considerations of respect and conservation to all other forms of life in the Universe. This resonates with some of the thinking coming from SETI scientists themselves. McKay comments that the discovery of alien life, if alive or revivable, will pose fundamentally new questions in environmental ethics (McKay, 2011). He suggests that while life is not the only source of value in the natural world, it is unique in that it is something of value that can be preserved, but it can also be spread without limit. If life has value, then

humans can create value and spread value as they spread life. However, human action can also cause damage, for example, in biological contamination associated with exploration of potentially biological worlds such as Mars. The search for life on Mars may give positive results because of life carried from Earth. Also, alien life-forms native on Mars may be endangered by competition with transplanted Earth-life. He proposes that we must explore Mars in a way that is biologically reversible (McKay, 2009; McKay, 2010).

The picture of spreading life without limit resonates in a small way with the foundation of the people of Israel in the Old Testament, when God promises Abraham to make his descendants 'as numerous as the stars in the sky and as the sand on the seashore' (Genesis 22:17). I am not suggesting, of course, that this becomes a cosmic mandate to the human race! However, there is a sense in which the Bible gives encouragement to explore God's Universe. Yet at the same time, the descendants of Abraham had to learn to care for the land, and to see that God's purposes were not just for them. They had to understand their own identity in relation to God, the environment, and others. On the more cosmic scale, SETI poses that question of all humanity.

## 9.2 A New View of What it Means to be Human?

Ernest Barnes, Bishop of Birmingham, in his Gifford Lectures in Aberdeen (1927–29), suggested that there are likely to be many inhabited worlds. The lectures were published in 1933 as *Scientific Theory and Religion*, and sought to bring Christian doctrines together with the possibility of life on other planets (Barnes, 1933). His argument depended on three strands which we met in a slightly different guise earlier in this book. First, God had created the Universe for the emergence of consciousness, therefore consciousness would not be confined to just one world. Second, it is likely that there are many planets like our own in such a vast Universe. Third, as the origin of life could be explained by physical processes, there was nothing special in the emergence of life. Barnes believed that the Creation was made precisely for the higher forms of consciousness.

In the early part of the twentieth century this attracted a great deal of criticism. It was fine to suggest that the creation was made for a higher form of consciousness, but to broaden it beyond humankind was seen to devalue human beings as the image of God.

Kepler once wrote: 'How can all things be for man's sake? How can we be masters of God's handiwork?' The possible success of SETI seems for many people to relegate human beings from their special place in the

Universe, and is seen to be a particular problem for religions such as Christianity. In what sense, if there is widespread ETI, can it be claimed that human beings are 'special'? As Seth Shostak provocatively puts it: 'Self-aware, thinking beings might be a competitor for God's attention and a threat to our importance' (Shostak, 2008: 176).

This is not just a question for religion and SETI. The question of the difference between human beings and other life is continually being highlighted by developments in biological sciences and in technology.

For example, is it acceptable to carry out experiments on animals? This has become a very controversial topic in recent years (Monamy, 2009). While most people would condemn the unnecessary suffering of animals to perfect certain perfumes, it is not so clear when it comes to experiments designed to alleviate human suffering. In 1921 Frederick Banting and Charles Best experimented on dogs in a process which was to lead to the discovery of insulin and relief for millions of diabetics. Was this justified? Is there something special to human life, whether it be worth or dignity, which allows us to do to animals what we do not do to other people?

The Human Genome Project has shown us just how similar our genetic make-up is to the rest of the natural world. Comparative studies of animal and human physiology and behaviour show that there are often differences of degree rather than kind (Morris, 2005; Corbey, 2005). Other differences between animal nature and human nature have been suggested:

- Ability to learn, plan, and conceptualize.
- Artistic sense.
- Ability to integrate a wide range of different areas of knowledge.
- Ability to make intuitive acts of judgement (which is often seen in science).
- Moral sense.
- Capacity for language and abstract thought brings with it power to reflect on pain and death.
- Ability to understand abstract mathematics and then use such mathematics to ask fundamental questions such as the origin of the Universe.

However, might many of these things be brought into an evolutionary explanation, further closing the gap between humans and animals?

Of course, this question of how special human beings are is also of contemporary interest in the development of artificial intelligence. The growth of neural networks and situated robotics provokes the question of whether a machine will become conscious, and then how human it will be (Herzfield, 2002; Boden, 2002; Christian, 2012).

Faced with these questions, some religious views deny evolution, deny the possibility of machine consciousness, or posit an immaterial soul to maintain the distinctiveness of human beings (Crawford, 2012b). At the other end of the philosophical spectrum is the view that the special worth of human beings cannot be maintained.

### *9.2.1 Human beings in the context of worship*

The question 'What are human beings?' has been central to much religious thought and tradition. Within the Judaeo-Christian tradition it is right at the heart of Psalm 8, which is often quoted in discussions of SETI, to make a range of points—which are sometimes contradictory! It might therefore be worth spending just a moment looking at this ancient hymn:

> 1 O Lord, our Lord,
> how majestic is your name in all the earth!
> You have set your glory
> above the heavens.
> 2 From the lips of children and infants
> you have ordained praise
> because of your enemies,
> to silence the foe and the avenger.
> 3 When I consider your heavens,
> the work of your fingers,
> the moon and the stars,
> which you have set in place,
> 4 what are mere mortals that you are mindful of them,
> human beings that you care for them?
> 5 You made them a little lower than the heavenly beings
> and crowned them with glory and honor.
> 6 You made them rulers over the works of your hands;
> you put everything under their feet:
> 7 all flocks and herds,
> and the beasts of the field,
> 8 the birds of the air,
> and the fish of the sea,
> all that swim the paths of the seas.
> 9 O Lord, our Lord,
> how majestic is your name in all the earth!

Psalm 8 is a hymn of praise, though it has proved difficult for scholars to fit it into a precise mould. Debate continues as to its connection with wisdom material, similarities to the form of the lament, its authorship, the era when

it was written, and how it was used in worship (Craigie and Tate, 2004: 105). It is certainly true that this psalm has been used regularly in both individual and corporate worship of both Jewish and Christian communities, and reflects strongly the language and theology of Genesis 1.

The refrain referring to how majestic is the Lord's name directs the worshipper both at the beginning and end of the psalm to the one who is to be worshipped (vs1, 9). God's majesty and glory are present throughout the earth and are greater than the heavens (v1).

Then from this picture of majesty, the psalmist asks the obvious question (v4). What are human beings in relation to this? Gazing at the Moon and stars, the vastness of the heavens emphasizes the majesty of this God, but also the seeming insignificance of human beings.

Pascal (1623–1662) wrote:

> *When I consider the short duration of my life, swallowed up in the eternity before and after, the little space which I fill, and even can see, engulfed in the infinite immensity of spaces of which I am ignorant, and which know me not, I am frightened, and am astonished at being here rather than there; for there is no reason why here rather than there, why now rather than then. Who has put me here? By whose order and direction have this place and time been allotted to me?…The eternal silence of those infinite spaces frightens me. (Pascal, 1958: 61)*

The response of the psalmist is that human beings have significance in the light of God's revelation. The psalmist rejoices in the place given to human beings by God. In order to understand human beings in the context of creation you need God's revelation. This is an important caution to those who would try to prove God through science or logic using the Universe alone. The real significance of human beings is not to be seen in anything inherent within human nature, but is to be seen in what God has done. Verses 5 to 8 stress the initiative of God:

- 'you made' (v5)
- 'you crowned' (v5)
- 'you made' (v6)
- 'you put' (v6)

Verses 6 to 8 fill out the Genesis command, giving human beings a role of stewardship in terms of domestic and untamed animals, birds, and fish.

The final refrain of praise reminds us of how this can be known. That is, God has revealed himself to human beings in a particular way. 'O Lord, our Lord' uses the name of Yahweh, the name revealed to the Jewish people,

the special name of God who had saved them and delivered them from Egypt. This Creator God was also their covenant God, revealed in his actions in the spacetime history of the Universe.

If this is simply arrogance on the part of the religious writer, then Pascal responds:

> *If we would say that man is too insignificant to deserve communion with God, we must indeed be very great to judge of it. (Pascal, 1958: 140)*

### *9.2.2 Human beings in the image of God*

If Christian theology, based on scriptural passages such as Psalm 8, sees the significance of human beings in terms of what God has done in revelation and relationship, does it therefore take the line that human beings are totally distinct from everything?

First of all, we need to recognize the continuity between human beings and the rest of creation. For example, in the week of creation described in Genesis 1, both animals and humans are created on the same day (Genesis 1:24–31), and in the more specific second chapter, 'the Lord God formed the man from the dust of the ground' (Genesis 2:7). That Adam was created from dust stresses the relationship of human beings with the rest of God's creation (see Genesis 2:19). In one sense, we are part of the same creation and creative process as the rest of life on this planet. Therefore, we should not be worried that we share much both in terms of our biochemistry and some of our behaviour patterns with animals. It is because we are an integral part of the natural world that we can do science on ourselves.

O'Meara states:

> *Apart from a few allusions to angels or demons, Christian revelation does not mention the relationship of God to other intelligent creatures. (O'Meara, 2012: 13)*

This may be the case, but Christian revelation is full of descriptions of the non-human natural world as part of God's creative activity, which has continuity with the nature of human beings. In the same way, it is not too difficult to see any non-human ETI also as part of God's creation.

However, the Bible does not say that humans are 'nothing but' dust. If the first part of Genesis 2:7 points to the origin of human beings in nature, the second part points to something which marks humanity out as different, 'the Lord God…breathed into his nostrils the breath of life, and the man became a living being'. Now the phrase 'living being' is also used of animals. However, the picture here is of God directly giving his breath; that is,

it is a picture of intimate relationship, quite different from the rest of creation.

This is more forcefully expressed in Genesis 1:26–28:

> *Then God said, 'let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over the livestock, over all the earth, and over all the creatures that move along the ground.'*
>
> *So God created man in his own image, in the image of God he created him; male and female he created them.*
>
> *God blessed them and said to them, 'Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground.'*

Compared to other living creatures on the Earth, human beings alone are given a privileged and responsible position. They alone are made in the image and likeness of God, with considerable responsibility to rule wisely over the rest of God's creation. But what does it mean to be created 'in our image, in our likeness' (v 26)? It is the type of phrase that is used a great deal by Christian theologians but has always proved difficult to fully understand.

The precise meaning of 'image' is difficult because of its rarity in the Bible and uncertainty about its etymology. This is then overlaid by 2,000 years of the attempt of Christian systematic theology to give a precise definition. Even a cursory glance at the history of the various interpretations of 'image' may warn us as to the dangers of too simple an interpretation (Clines, 1998).

First, the image was seen as a physical embodiment of God. In the fourth century the Anthropomorphites and Audiani argued that God is physically embodied and that human beings are physically the image of God. This never was widely accepted. Second, 'image' has been suggested as referring to human reason which mirrors the wisdom of God. Augustine spoke of the 'footsteps of the Trinity' comprising intelligence, memory, and will in human beings. Aquinas also saw the image of God in this way. Third, image has been linked to freedom. Being made in the image of God means that human beings are free, self-determining, and self-transcending. Our free will and creative activities are a reflection of the nature of God. Fourth, moral sense has been suggested to be what it means to be created in the image of God. God is holy and righteous, and human beings reflect this moral sense. Calvin characterized 'image' as being 'in the light of the mind, in the uprightness of the heart, and in the soundness of all its parts'

(Calvin, 1936: 15.4). The weakness of these attempted definitions is that they actually pay little attention to the Genesis text itself.

In recent years, studies in the language and context of the ancient Near East have helped in a deeper understanding of 'image'. It needs to be understood against a background of being a representative. Egyptian and Assyrian texts sometimes describe the king as the image of God, meaning God's representative on Earth. Such concepts seem to be in the Genesis text. Certainly there is a close connection in the text between made in the image of God and God's command to exercise dominion over the natural world (Genesis 1:26–28). To rule (v26) and subdue (v28) are royal tasks. Furthermore, physical images of gods and kings in terms of statues erected in cities or conquered nations were viewed as representatives of the deity or king, even to the extent of a god being thought of as indwelling an idol by his spirit. The image represented the one imaged, and the presence of an absent lord.

Furthermore, the image of God is not part of the human constitution so much as it is a description of the process of creation that makes human beings different. The image should not be imagined to be a 'part' of the human being, whether body, reason, or moral sense. It is much more about relationship. The Old Testament scholar Claus Westermann writes: 'Human beings are created in such a way that their very existence is intended to be their relationship to God' (Westermann, 1984: 158). This is emphasized often later in the Genesis account. God walks in the garden with Adam and Eve, and he speaks in a different way to them than to the rest of creation. He speaks personally, while they understand and respond. This is a point that has been explored by many early and contemporary theologians. Athanasius (*c.*296–373) spoke of the image of God as the capacity to relate to and partake in the life of God, while the twentieth-century theologian Emil Brunner spoke of it as 'existence for love' (Brunner, 1966: 57).

From this foundation, other aspects can be added. Karl Barth pointed to the importance of verse 27 in the Genesis account; that is, human beings are created as male and female in community. Thus Jürgen Moltmann states: 'Likeness to God cannot be lived in isolation. It can only be lived in human community' (Moltmann, 1985: 222). Additionally, the responsibility to be stewards of the Earth has within it the gift of creativity, and so Philip Hefner coined the term 'created co-creators' to describe human beings made in the image of God (Hefner, 1993). God gives human beings responsibility and ability not only to care but also to innovate within the context of his creation and his will.

Thus Christian theology understands the special nature of human beings, not primarily in terms of physical difference from the rest of

creation, but in the fact that they have been given an intimate relationship with the Creator God. Of course, that relationship is received by embodied persons in community, with a call to responsible and creative stewardship of the Earth.

Karl Barth was one of many theologians who pointed out the importance of seeing the image of God from the perspective of Jesus Christ. Thus when Paul describes Jesus as the image of the invisible God (Colossians 1:15), he is saying that Jesus is the decisive norm for both divinity and humanity. Furthermore, God's special love towards human beings is shown most of all by what Christians call the doctrines of incarnation and redemption. Incarnation is God becoming a human being in Jesus, and living as a human being in the spacetime history of the Universe. Redemption is God dying a human death to restore that intimate relationship which has been destroyed by turning away from him. It is because of these acts of God that the special nature of human beings is not undermined by the existence of other life.

The Christian faith is already accustomed to dealing with plenty of non-human life in the Universe. The Earth itself is teaming with non-human life, from amoebae to elephants, and this has not caused Christianity any major problems. This natural world is part of God's rich creation, in which he exhibits diversity, extravagance, and beauty. Bacteria on Mars would simply be part of this great creation tapestry.

Westermann comments:

> *The simple fact that the first page of the Bible speaks about heaven and earth, the Sun, the Moon, and stars, about plants and trees, about birds, fish, and animals, is a certain sign that the God whom we acknowledge in the Creed as the Father of Jesus Christ is concerned with all these creatures, and not merely with humans. A God who is understood only as the god of humankind is no longer the God of the Bible. (Westermann, 1984: 176)*

If the God in the Bible is interested in the whole of the natural world, Christian tradition has also indicated the presence of other life-forms in a realm beyond this creation; that is, angelic beings (Williams, 2002; Jones, 2010). While the angelic tradition is far beyond the scope of this book, it is worth noting that the biblical world is not simply about human beings and God. The Lordship of Jesus Christ extends over all creation and new creation, thus giving a much bigger perspective than just men and women.

What about other intelligent life? Some Christians suggest that humans are unique only in the context of planet Earth. There could be ETI, but this

could be in the image of God for its own planet. This is a possibility, though other Christians argue that the Bible does see the stewardship of human beings being linked to God's purposes for the whole of creation, not just the Earth. This is a difficult argument to solve, not least in that the biblical authors have a very anthropocentric perspective on the acts of God that they are recording.

Nevertheless, I suggest that God's care is never exclusive. Humanity may be unique in its relationship to God. However, uniqueness does not imply exclusiveness. I have a unique and special relationship with my wife, but that does not mean that we do not relate to any other person at all. There are different degrees of friendships and family relationships with many people. Even relationships at the same level can be unique and special. We have a unique relationship with our son which is very special indeed. However, that is not to say that we do not have an equally special but different relationship with our daughter.

It is interesting that this picture resonates with some recent work in environmental sociology. Dunlap and Catton have argued that traditional sociological perspectives were dominated by what they have called a Human Exemptionalism Paradigm (HEP). This viewed a fundamental separation between humans and the rest of the animal world, and that sociologists should focus on a social and cultural environment that is discrete from biophysical considerations. They suggested, however, a New Ecological Paradigm (NEP), where humans, while still exceptional, remain just one of many species that co-evolved in the same global ecosystem, and that humans live within a finite biophysical environment (Dunlap and Catton, 1979).

Stevens wants to push this forward to reconsider the importance of embodiment in sociology (Stevens, 2012). He suggests that as embodied beings we can fully understand who we are only by having an awareness of our physical nature; as embedded beings, self-understanding can come only if we are equally aware of our physical environment (Stevens, 2009). By extension, he then proposes a concept of *embedment*. By this he means that our inclusion in the environment is an essential part or characteristic of our selves, meaning that who we are is intimately connected to where we are, as individuals and as societies (Stevens, 2010).

Some theological paradigms have followed a similar human exemptionalism. But human beings can still be exceptional while noting that they share embodiment and embedment in Stevens' terms. Indeed, that embedded location on the Earth is intimately connected with who we are as individuals and as a human society. But theology wants to go further than just

the physical environment. It is how human beings are embedded in the story of God's acts, supremely focused in Jesus.

It may be, therefore, that we can begin to see human beings as still exceptional but not unique as intelligent life in the Universe. Sharing much with other life-forms—even perhaps intelligence and self-consciousness—human beings are embedded in the story of God's particular acts. This is not an appeal to human superiority. It is about exceptional relationship but not exclusive relationship. Human beings can be special without denying God's love and concern for other intelligent beings. As Peters rightly notes:

> *The existence of a more advanced extra-solar civilization does not preclude our being an object of divine concern. Contact with alien intelligence will not disenfranchise us from the imago dei. (Peters, 2011: 653)*

The Christian understanding of God goes further. He is a God of relationship. His very being as Trinity, experiencing and giving love within the three persons, demonstrates that supremely. It also means that God does not need to create human beings. The poem 'The Creation' by James Weldon Johnson (1871–1938) begins:

> And God stepped out on space,
> And He looked around and said,
> 'I'm lonely—
> I'll make me a world.' (Johnson, 1922)

God in Trinity is not lonely. The Father, Son, and Spirit are already experiencing love. Thus human beings are not needed for God to be fulfilled. Human beings are created by grace.

God's incarnation in Jesus of Nazareth is a visible sign of the love which breaks through walls of racism, nationalism, and sexism. That was a lesson that the people of Israel had to learn over and over again. This nation, chosen by God for particular purposes, enjoyed a special relationship with him. That did not mean, however, that God's purposes were restricted just to that nation. God's love was for all, for Jew and Gentile alike.

On the basis of this, if there were intelligent life elsewhere in the Universe, I would expect God to be in relationship with that life.

We can go further. The value and care of the environment is central to the Bible. It has been a mistake to ignore this and believe that human beings alone have value—a mistake which has led partly to our environmental crisis. We should not make a similar mistake in terms of extraterrestrial life and intelligence. If it exists, then it has value as God is the creator of all

things. From bacteria on Mars to aliens in flying saucers, we have a responsibility to respect and indeed to discover more about them, for we could learn more about God's extravagance in creation. This is a biblical prime directive.

Extraterrestrial intelligence does not pose a problem to Christian belief that men and women are special in the eyes of God. It may even increase the sense of awe at how great this God is, who loves his creatures so much. As Haught comments:

> *Contact with ETs would provide an exceptional opportunity for theology to widen and deepen its understanding of divine creativity. (Haught, 2003: 179)*

As we saw earlier in Chapter 2, Russell argued that the popularity of the speculation about other worlds in the seventeenth century was in part due to the biblical understanding of creation. The reason being that in the Aristotelian Universe, position and status were closely associated. The Earth was at the centre of all things, separated from the rest of the Universe by the orbit of Moon. We were special because we were placed at the centre. In contrast, Christian theology does not associate status and place. The dignity and worth of human beings comes from the gift of relationship with God.

Human beings are not the centre of the Universe. In fact, it is the human belief that we are the centre of all things that the Bible calls sin. It leads to the arrogant treatment of the rest of the created order and the breaking of human relationships. Some writers give the impression that our destiny is to control the Universe. That is not the biblical view. God is the centre of all things, and we are creatures given status by his love. As Clarke rightly states, 'we are not the central focus of all that is. All life reflects God's glory, not ours' (Clarke, 1996).

This sense that ETI would both reflect and see the glory of God, as history shows, is a major encouragement to the belief in such life. It is interesting that it was Catholic thinkers who engaged most with the question of extraterrestrials in the early part of the twentieth century. At the turn of the century, taken with the diversity and lawful structure of the Universe, Januarius De Concilio and Joseph Pohle used the astronomy of their day to make a number of arguments for intelligent life on other planets (Concillio, 1889; Pohle, 1899). They also used a theological argument that a Universe devoid of life would waste God's creative power. Pohle's book was very popular, and no doubt contributed to a number of later thinkers. After the Second World War, once again there was interest among Catholic thinkers,

this time with the added spur of the new astronomy and the space age. From the 1950s onwards authors such as Domenico Grasso, Joaquin Salverri, Angelo Perego, Charles Davis, T. J. Zubek, John P. Kleinz, and Daniel C. Raible, on the basis of the immensity of the Universe, came to think that there must be extraterrestrial life (Davis, 1960; Raible, 1960; Kleinz, 1960; Zubek, 1961; Vakoch, 2000; O'Meara, 2012: 86–7). In fact, writing in 1962, the Executive Secretary of the American Rocket Society claimed that the 'liveliest speculation' about ETI came from Roman Catholic theologians (Harford, 1962: 19). It is therefore interesting to ask the question of why there was such openness among Roman Catholics. One could point to the influence of the Vatican Observatory, or to the fact that theological speculation was not constrained by the biblicism of many Protestant churches. But I wonder if it was due to openness to a world beyond human beings. Under a bizarre headline in 2010, Guy Consolmagno, a Jesuit and Vatican astronomer, said that he would be delighted if we were to encounter intelligent aliens, and would be happy to baptize them. But he went on to say: 'God is bigger than just humanity. God is also the god of angels' (Alleyne, 2010). Perhaps in Catholic spirituality there is a greater capacity to see beyond humanity.

Karl Rahner was another Roman Catholic who was also open to the existence of extraterrestrial life (Rahner, 1957). Indeed, in 1981 he was greatly influenced by the size of the Universe, concluding that it 'is not easy for an individual to see Earth as the reality for which the Universe exists' (Rahner, 1983: 56). But he still wanted to see how this might be reconciled with theology's emphasis on the importance of the human race and the incarnation of God as a human being. It is this latter question that we will explore in the next chapter.

# 10
# SETI and the Christian Understanding of Redemption

As we have seen, a great number of Christians and Church leaders remain relaxed about the success of SETI (Peters, 2003: 129–34; Jakosky, 2006: 117–21), but there are some Christians who reject SETI on theological grounds. They believe that human beings are alone in the Universe, and therefore it is a waste of time and money to search for other life (Hunt, 2010). This belief is energized by both the doctrine of creation and the doctrine of redemption: the Genesis account is understood literally; human beings are thought to be unique in creation (Van Huyssteen, 2006); ETI is not mentioned in the Bible (Mardis, 2009); the death of Jesus on the cross has once for all cosmic significance; and alien encounters can be put down to the work of demons and angels.

Wiker sees the belief in aliens as a consequence of the belief that the world was created by chance rather than by God. Furthermore, he argues that the Bible is clear that the Universe is already populated with intelligent extraterrestrials, but they are angels. Most importantly, because of the incarnation of Christ,

> *human beings were thereby placed at the centre of the cosmic drama, which made no room for questions about the redemption of other intelligent beings… I am as prepared for the arrival of extra-terrestrials as I am for that of elves, and for the same reason: All evidence points to their non-existence, and yet it remains a very, very remote possibility—so remote that to change our central doctrines to accommodate either possibility would be folly. (Wiker, 2002)*

However, at the other end of the spectrum of views are Christians who want to rethink the whole belief system of Christian faith. The biologist and theologian Arthur Peacocke proposed:

> *Does not the mere possibility of extraterrestrial life render nonsensical all the superlative claims made by the Christian Church about the significance (of Jesus). (Peacocke, 2000: 89)*

In a similar way, Norman Pittenger bemoaned:

> *How can the Christian gospel, concerned with the salvation of men in this world, have any universal significance when we know that there may well be intelligent life on other planets. (Pittenger, 1959: 248)*

It is worth noting in passing that this, of course, is a particular question for Christianity. Michael Waltemathe has pointed out that other faiths would have no problem in thinking that God may have sent prophets or messengers to ETIs, and indeed Hinduism may easily accommodate other gods in other worlds (Allen, 2011).

Yet mainstream Christian theology has often been silent on this issue. In this it seems to have missed an opportunity. As Peters has reminded us, the theologian wants to ask the question of what this says about God, and in this context of SETI we can ask questions which explore the universality and particularity of Christian theology—even if the scientific evidence is not conclusive one way or the other. Peters advocates 'exotheology'; that is, speculation on the theological significance of extraterrestrial life (Peters, 2003: 121).

Stallard has drawn an interesting parallel with an issue which was a theological controversy among the early Church fathers (Stallard, 2009). The possibility that the Earth was not flat but in fact was a sphere raised the question of antipodes; that is, those on the other side of the Earth with 'their feet turned towards our feet'. Church Fathers such as Augustine in the fifth century were open to the idea of a spherical Earth, but struggled with the existence of antipodes:

> *As to the fable that there are Antipodes, that is to say, men on the opposite side of the Earth, where the Sun rises when it sets on us, men who walk with their feet opposite ours, there is no reason for believing it. Those who affirm it do not claim to possess any actual information; they merely conjecture that, since the Earth is suspended within the concavity of the heavens, and there is as much room on the one side of it as on the other, therefore, the part which is beneath cannot be void of human inhabitants. They fail to notice that, even should it be believed or demonstrated that the world is round or spherical in form, it does not follow that the part of the Earth opposite to us is not completely covered with water, or than any conjectured dry land there should be inhabited by men. For Scripture, which confirms the truth of its historical statements by the accomplishment of its prophecies, teaches not falsehood; and it is too absurd to say that some men might have set sail from this side and, traversing the immense expanse of ocean, have propagated there a race of human beings descended from that one first man. (Augustine et al., 1958: XVI.9)*

Augustine argued against the existence of antipodes for a number of reasons. First, he was very practical. If, as was generally held, the sea was too wide to sail across or the equatorial zones too hot to pass through, how were we ever to be able to find out whether there were others on the other side of the world (Russell, 1991)? Second, he pointed out that even if the Earth was a sphere there was no telling where the conditions for life would be right for life. Third, he was concerned about how such human beings were related to Adam, and so break the unity of the human race. How could humans who were descended from Adam end up on the other side of the world, as the Bible seemed to say that all were descended from Adam? (Acts 17:26). Fourth, if they were not related to Adam would they share in original sin and redemption? This seemed to encroach upon the fundamental Christian dogma of the unity of the human race, and the consequent universality of original sin and redemption.

The issue also appears in a letter from Pope Zachary in 748, addressed to Boniface, critical of a missionary among the Bavarians named Vergilius, who may have been the later Archbishop of Salzburg (Loughlin, 1907; Moretti, 1993). Among a number of errors, the Pope points to the belief of 'that beneath the Earth there was another world and other men, another Sun and Moon'. Again, the resistance coupled practical matters with spiritual matters. If the journey was impossible, then how could the Church respond to the command of Jesus to make disciples of all? This left the possibility that Christ would either have appeared a second time in the antipodes, or these people could not be redeemed. In the fifteenth century this was argued by the Spanish theologian Alonso Tostado as a response to Columbus' proposal to sail westwards (Colâon and Keen, 1960: 62).

The theological uncertainty concerning the spiritual status of antipodes turned many in the Church against not only their existence but also back to a flat Earth. It is one of a few examples of the way that theological speculation may have inhibited discovery, and is interesting to contrast the way that later theological conviction spurred the scientific revolution and thinking about a plurality of worlds. Indeed, when Columbus and others discovered people in different parts of the world, the Church recognised that they were part of Adam's family and sent missionaries to share the good news of Jesus.

The history of the antipodes is fascinating for a number of reasons in our discussion of SETI. It highlights some of the theological issues. How might an ETI be related to the Christian story of Jesus, its understanding of sin and redemption? As Stallard comments: 'The Church has been to this doorstep before, although the step here would be much longer.'

All we can do at this stage is to take a small step into some key questions in Christian theology that are opened by the door of SETI.

## 10.1 The Cosmic Significance of Jesus

There is a central issue shared by all of the Abrahamic faiths. That is, God has revealed himself at particular times, in particular ways to particular people. Whether in the events of the Exodus, the words of the Qur'an, or in the life, death, and resurrection of Jesus of Nazareth, the specific revelation has universal significance. This issue of particularity means that for many in Christianity, ETI is difficult to hold with the revelation of God here on Earth.

One possibility that has been pursued by some Christians is to see this revelation as only for human beings. Thus Christopher Corbally, an astronomer at the Vatican Observatory, reflecting on the consequences of the possible success of SETI, says: 'While Christ is the First and the Last Word (the Alpha and the Omega) spoken to humanity, he is not necessarily the only word spoken to the whole Universe.' The theologian Thomas O'Meara argues: 'The history of sin and salvation recorded in the two testaments of the Bible is not a history of the Universe; it is a particular religious history on one planet…the central importance of Jesus for us does not necessarily imply anything about other races on other planets…Believers must be prepared for a galactic horizon, even for further Incarnation' (Wiker, 2002).

The important theological theme here is the relationship between revelation and incarnation as Christians think about the person of Jesus.

While this is presented in many parts of the Bible, perhaps the best example is from Paul's letter to the Colossians:

> [15] *He is the image of the invisible God, the firstborn over all creation.* [16] *For by him all things were created: things in heaven and on earth, visible and invisible, whether thrones or powers or rulers or authorities; all things were created by him and for him.* [17] *He is before all things, and in him all things hold together.* [18] *And he is the head of the body, the Church; he is the beginning and the firstborn from among the dead, so that in everything he might have the supremacy.* [19] *For God was pleased to have all his fullness dwell in him,* [20] *and through him to reconcile to himself all things, whether things on earth or things in heaven, by making peace through his blood, shed on the cross. (Colossians 1:15–20)*

Some disagreement continues between biblical scholars over the Pauline authorship of this letter and both the nature and existence of a particular

'heresy' to which the writer was responding (O'Brien, 1982; Wright, 1986; Dunn, 1996). My own view is that the evidence for Pauline authorship is strong, and that there were a number of ideas attractive to the Colossian Christians from both Jewish and Gentile sources which questioned the supremacy of Jesus (Wilkinson, 2002: 142). Since the work of Norden it has been widely accepted that Paul borrowed an already existing piece of a hymn or liturgy. This hymn is applied to speak of the supremacy of Jesus in revelation, creation, and redemption (Norden, 1923; Robinson, 1957; Hay, 2000).

Paul is explicit in saying that the Creator God is known supremely in Christ. Jesus is the 'image of the invisible God' (v15), the projection of God himself into the dimensions of spacetime in a way that reveals his true nature. In answer to the question of how the Creator is known, Christians respond that he is known through his revelation in Jesus Christ.

Later in the passage Paul claims that in Jesus 'all the fullness of God was pleased to dwell' (v19), or as Tom Wright translates, 'God in all his fullness was pleased to take up permanent residence in him'. Paul re-emphasizes such an understanding in Colossians 2:9: '. . . it is in him that all the fullness of deity dwells in bodily form'. Does that mean that Jesus was fully God but not really human, as if God came to Earth just with the outward appearance of humanity? But Paul will not allow that, arguing for both full divinity and full humanity through reference to the physical body (v22) and 'bodily form' (Colossians 2:9).

Karl Barth put this forcibly:

> *I believe in Jesus Christ, God's Son our Lord, in order to perceive and to understand that God the Almighty, the Father, is Creator of heaven and earth. If I did not believe the former, I could not perceive and understand the latter. (Barth 1936: 29)*

This is so often misunderstood or ignored. For example, Richard Dawkins is quite correct in arguing that what he defines as his 'God hypothesis' is a delusion (Dawkins, 2006: 31). But it is defined by refusing to engage with any particular expression of religious belief or revelation, and it therefore speaks of God in the broadest possible philosophical sense. He then goes on to show that the design and cosmological arguments do not work. The Christian theologian agrees. However, the point is that for Christian theology the Universe cannot be fully understood as creation without Christ.

C. F. Burney argued that in the Colossians passage, Paul echoes the understanding of 'wisdom' in the Old Testament, where God creates

the world through wisdom (Burney, 1925–26). For Paul the creative work of God is expressed not through a concept or indeed a personification of a divine attribute or holy law, but through the person of Jesus Christ.

Carl Sagan once wrote:

> *How is it that hardly any major religion has looked at science and concluded, 'This is better than we thought!' The Universe is much bigger than our prophets said, grander, more subtle, more elegant.' Instead they say, 'No, no, no! My god is a little god, and I want him to stay that way'. A religion, old or new, that stressed the magnificence of the Universe as revealed by modern science might be able to draw forth reserves of reverence and awe hardly tapped by the conventional faiths. (Sagan, 1995b: 50)*

This is somewhat unfair to Christians, and misunderstands the scale of belief in Jesus Christ. Here in this man of Nazareth, Paul locates the source and sustaining of the whole of the Universe. Jesus Christ is understood in a cosmic sense not only by the apostle Paul but by all the writers of the New Testament. He is Lord over creation who makes loaves and fish feed the 5,000, who stills the storm, and who heals those with physical needs. The people cry, 'what kind of man is this? Even the winds and the waves obey him' (Mattthew 8:27). The confident answer of the New Testament is that he is not only Lord over creation but Lord of creation. There is no way that the writers wanted a little god and wanted him to stay that way. The Jesus encountered by the first-century fishermen of the Lake of Galilee is the one through whom and for whom the Universe was created. He is the eternal Son, the Word of God.

However, what is the relationship between Jesus the human being, born in Nazareth and dying on a cross in Jerusalem, and Jesus the eternal Word of God? If there are other ETIs, might there be multiple incarnations?

One of the most imaginative thinkers in the Catholic engagement of science and religion was of course Teilhard de Chardin. Reflecting on the human role in evolution, he saw evolution happening in religious and cultural terms drawn forward by a future Omega Point. One might therefore expect a rather anthropocentric view of God's work in the Universe. Yet his view of cosmic redemption wanted to see the work of God on a much larger scale:

> *The hypothesis of a special revelation, in some millions of centuries to come, teaching the inhabitants of the system of Andromeda that the Word was incarnate on Earth is just ridiculous. All that I can entertain is the possibility of a multi-aspect Redemption which would be realized on all the stars. (Teilhard de Chardin, 1971: 44)*

As Lyons has pointed out, de Chardin sees Christ's redemption work on Earth as a single activity within a multiplicity of incarnations (Lyons, 1982: 214). If there is ETI, he would suggest that God became incarnate in an appropriate physical form.

Again, it is interesting to ask why so many Catholic thinkers engaged with this type of question. Perhaps it was a way of speculating on whether salvation was possible outside the Church. Indeed, Yves Congar linked the question of extraterrestrials to wider questions as to the nature of salvation. Salvation was not just about an individual believer but also about how God worked in different cultures and in different religions (Congar, 1961). He suggested the possibility of other incarnations, motivated by his understanding of the endless grace of God.

In 1957 the Protestant theologian Paul Tillich noted that the subject of extraterrestrial life was fascinating to the public but that few theologians were prepared to engage with it. He wrote:

> *How to understand the meaning of the symbol 'Christ' in the light of the immensity of the Universe… the infinitely small part of the Universe which man and his history constitute, and the possibility of other 'worlds' in which divine self-manifestations may appear and be received. (Tillich, 1953: 2.95)*

For Tillich, Christ could be manifested on other worlds at different times:

> *Incarnation is unique for the special group in which it happens, but it is not unique in the sense that other singular incarnations for other unique worlds are excluded. Man cannot claim to occupy the only possible place for Incarnation. (Tillich, 1953: 2.96)*

The poet Alice Meynell also picked up such a theme in a poem about incarnation in multiple worlds:

> But in the eternities,
> Doubtless we shall compare together, hear
> A million alien Gospels, in what guise
> He trod the Pleiades, the Lyre, the Bear.
> O, be prepared, my soul!
> To read the inconceivable, to scan
> The million forms of God those stars unroll
> When in our turn, we show them a Man. (Meynell, 1923)

Norman Pittenger argued that many find unnecessary difficulty with the view of multiple incarnations, because of 'Jesucentrism'. He defines this as

the belief that the human life of Jesus in Palestine is thought to give complete knowledge of God. However, the significance of Jesus is as the incarnation of the Eternal Word of God, the second person of the Trinity who becomes flesh in the man. This Jesus Christ is central and decisive for our human relationship with God—showing what God is like, what human beings are meant to be, the way of reconciliation, and restoration of our true nature. But he is not the whole of what God is about. 'For Christian faith, Jesus defines but does not confine God in his relationship to the created world' (Pittenger, 1959: 249).

Pittenger himself leaves open the question of whether God takes on the flesh of other intelligent life, but argues that the basic truth is that we would expect God to show the same interest, care, and judgement on other worlds. We must believe, however, that what God reveals in Christ is in continuity with what he is doing elsewhere. Jesus Christ is our clue to all God does anywhere and everywhere. Frank Weston, Bishop of Zanzibar, echoed this as early as 1920:

> *… if other planets support rational life … I am quite certain that Christianity is revealed to them in some way corresponding with its revelation to us. Our Christianity is the self-unveiling of eternal Love in terms and forms intelligible to us … their Christianity will be the self-unveiling of eternal Love in terms and forms intelligible to them … It is only those who erect a false barrier between the universal activity of the Word and his incarnate life as a man who will boggle at the possibility of his self-revelation in a created form on another planet. (Weston, 1920: 128–9)*

The importance of this view is that it emphasizes that incarnation is basic to who God is. It reminds us that self-giving love is at the heart of God. O'Meara has recently pursued this theme: 'As incarnation is an intense form of divine love, would there not be galactic forms of that love?' (O'Meara, 2012: 47) He goes on to speak of a multitude of incarnations, quoting Aquinas in the thirteenth century, who speculated that a divine person could become incarnate in a further creature other than Jesus. This view goes against the use of the incarnation to argue that human beings are the only intelligent life-forms in the Universe.

Once again there is an interesting parallel from another area of theological thinking. In recent decades there has been considerable attention paid to the value of the environment and in particular animals within the Christian understanding of creation (Linzey, 1976; Griffiths, 1982; Deane-Drummond and Clough, 2009). Andrew Linzey argued for a new attitude towards the

rights and value of animals by attacking Karl Barth's over-insistence that the incarnation is an affirmation of humanity alone, as Jesus did not come as 'angel or animal but man' (Linzey, 1998). This leads to Barth's distinction between the importance of human life over animal life. However, Linzey argues that the incarnation is not an affirmation simply of humanity but of 'God's Yes to creation' as a whole. We might add that the setting of the incarnation in the context of Jesus as Logos and creator of all creation (John 1:1–18; Colossians, 1:15–20; Hebrews 1:1–4) provides an understanding that includes the whole of creation. For Linzey, such a view of the incarnation gives a divine approval to animal life and welfare.

Using the same type of argument, we might suggest that the event of the incarnation here on Earth is not meant to say that human beings are the exclusive owners of God's affirmation. The particularity of God becoming a human being in Jesus of Nazareth is a divine affirmation of men and women, the biological world, and the physical world, which may or may not include ETI. As O'Meara rightly says: 'If, however, there are other intelligent creatures but no incarnations among them, then the union of the Logos and a terrestrial human would be a strong affirmation of the dignity of corporeal, intelligent life wherever it is found' (O'Meara, 2012: 50).

Yet are we led inevitably to the conclusion of multiple incarnations if there is ETI? We need to be cautious of this for four reasons. First, to drive a wedge too far between the 'cosmic Christ' and the 'human Jesus' does begin to open the door to the view that Jesus was just a good man used by God. As we have seen in the passage from Colossians, Paul's understanding is very far from this. Some Christians, noting this danger, do not want to go down this road of multiple incarnations.

Second, if God's nature is to reach out in love in embodied form, why should there not have been multiple incarnations in different cultures on the Earth? While Christian theology has always recognized that other faith communities have insights into truth, the incarnation of God in Jesus is still held to be supreme.

This leads us on to our third reason. That is, God does not only reveal himself to intelligent life-forms through incarnation. The Bible is full of other images of God communicating, including through visions, through awe at the natural world, through angelic visitations, through burning bushes, through dreams, through the written word, through prayer, and through prophets. At times, God's communication is mysterious, such as when Jacob wrestles with a man and indeed sometimes God stays hidden. We do well to remember that the incarnation is central, but not the only form of relational communication.

The fourth reason is perhaps the most important and the most difficult. In answer to the question 'Why did God become a human being in Jesus?', Christians reply that it was not only to show us the nature of the creator God, but also to save us from our sin. The incarnation is about both revelation and salvation. And as we have only one case to study—human beings—it is difficult to know whether incarnation always comes with both revelation and salvation.

To put it another way, the speculation of multiple incarnations not only raises the question of how ETI would know God, but also whether ETI would sin.

## 10.2 Do Aliens Sin?

Whenever the question of ETI and sin arises, theologians seem to go to the Space Trilogy of C. S. Lewis: *Out of the Silent Planet* (1938), *Perelandra* (1943), and *That Hideous Strength* (1945). In these works of fiction, Lewis explores human sinfulness, and how this sinfulness would affect life on other planets (Lewis, 1938; Lewis, 1943; Lewis, 1945). He is thus highlighting the question that if an alien race does exist, has it fallen in the same way as human beings? The difficulty of this is simply to know whether other life had rebelled in the same way. The attraction of Lewis may be because few theologians have engaged with the question, but it also may be that the difficulty of the question is better suited to a narrative approach to truth.

At the beginning of this chapter we saw in the discussion of antipodes that Augustine could not quite square the existence of other people with how they might be related to Adam, his original sin, and the salvation offered by Christ. Yet the understanding of sin within Christian theology is much more complex and subtle than just the transmission of original sin.

We first of all encounter the nature of sin, of course, in the early chapters of Genesis. Here it is in the context of the story of Adam and Eve, of trees, snakes, and apples. Yet this picture of rebellion against, and then alienation from, God has spoken to centuries of men and women in their own spiritual experience. As one commentator puts it:

> *The sin depicted is not simply the first sin; it is all human sin; it is my sin. And I who hear the tale am forced to acknowledge that my sin too has cosmic dimensions; my sin too is an attack on creation and an establishment of moral chaos. (Walsh, 1977: 177)*

This is a symbolic account of both the origin and reality of sin. It is a simple narrative account that communicates its main points clearly. It is also

a very skilfully constructed and subtle account of the reality and consequences of sin. Wenham reviews the options that different commentators have taken, and suggests that this passage is a 'protohistorical' story or tale. He comments:

> *…the author of these chapters identified the origin of the problems that beset all mankind—sin, death, suffering—with a primaeval act of disobedience of the first human couple. Whereas a modern writer might have been happy to spell this out in abstract theological terminology—God created the world good, but man spoiled it by disobedience—Genesis puts these truths in vivid and memorable form in an absorbing yet highly symbolic story. (Wenham, 1987: 55)*

We need to be careful of what we mean by terms such as 'original sin', especially if we then want to apply them to ETI. We need to note first that this text is used very sparingly in the rest of the Old Testament. In most of the Old Testament the reality of sin is understood without much reference to its origin. Certainly, in the New Testament, Paul locates the origin of sin in this account in order to show the act of redemption in Jesus Christ (Romans 5:12).

Within this highly symbolic account of sin in Genesis, it communicates clearly the reality and consequences of sin. Sin is about the rejection by human beings of their Creator and provider. We are tempted into it by distorted understanding, and seduced by the attractive nature of selfish ambition. Kidner comments, ' "To love and to cherish" becomes "To desire and dominate" ' (Kidner, 1967: 47). The consequences are spelt out as broken relationships. The harmony of the created order is disrupted. Human beings disrupt their intimate relationship with God, with themselves, with one another, and with creation itself.

This fall into sin means that that which was good is now tinged with difficulty. The fertility and ease of gathering food to eat in the garden is now replaced by the need for painful, difficult, and tiring work. Human sin has led to the land being cursed, which means it does not fulfil its potential for beauty and usefulness. This is because its chief steward is not in harmony with God and therefore does not care for it in the way it should be cared for. That is, 'an untended garden is one which is overrun by thorns and thistles' (Berry, 1995).

Traditionally, Christians have struggled to describe the effects of human sin on the natural world. Is it simply that the natural world is out of sorts because we can no longer till and serve creation in a way that makes it live up to its beauty and usefulness, or is there a fundamental

change in nature? The difficulty that Christians have had in trying to answer the question is that Genesis 2 and 3 contain very little data to make a judgement on this. Rather than earthquakes and storms being a result of the fall, perhaps in our disrupted relationships we no longer have the strength to cope with such things.

However, what of the relationship of human sin beyond the Earth? All that has been discussed above could simply apply to human beings in relationship with the Earth. Yet are there deeper issues here? In Romans 8:19–22, Paul writes:

> *The creation waits in eager expectation for the sons of God to be revealed. For the creation was subjected to frustration, not by its own choice, but by the will of the one who subjected it, in hope that the creation itself would be liberated from its bondage to decay and brought into the glorious freedom of the children of God. We know that the whole creation has been groaning as in the pains of childbirth right up to the present time.*

Does this mean that human sin has affected the whole Universe? The New Testament scholar C. E. B. Cranfield used the following picture:

> *What sense is there in saying that 'the subhuman creation—the Jungfrau, for example, or the Matterhorn, or the planet Venus—suffers frustration by being prevented from properly fulfilling the purpose of its existence?' The answer must surely be that the whole magnificent theatre of the Universe, together with all its splendid properties and all the varied chorus of subhuman life, created for God's glory, is cheated of its true fulfilment so long as man, the chief actor in the great drama of God's praise, fails to contribute his rational part . . . just as all the other players in a concerto would be frustrated of their purpose if the soloist were to fail to play his part. (Cranfield, 1974: 413)*

This way of seeing that the proper relationship between human beings and the physical Universe has broken down is perhaps the most helpful way of thinking about the universality of sin.

Would, then, a similar story be true of aliens? There have been theologians who have suggested that aliens would help us see more of God:

> *Knowledge of extraterrestrials would help us penetrate the wisdom of the plans of God and the evil of sin. If they live in a state of justice they would not have committed original sin, and we would see the immensity of all that was lost by our ancestors through sin. In the case of a redemption like ours we would see the special love of God for us in terms of a further experience of this love. (Grasso, 1952)*

Certainly, in the fiction of Lewis, evil is rare and the Earth has to be separated from other life so that sin does not spread. Similar themes are explored in James Blish's science fiction novel *A Case of Conscience* (1958). A team of scientists, including a Jesuit priest, make contact with an alien race that follow perfectly Christian morality but have no sense of God or any religious practice. They encounter an alien utopia without crime, conflict, ignorance, or need. The book is interesting, not least in that it gives the responsibility of how to take a relationship forward with Earth's first contact of aliens to a team of four people, including a priest.

The priest, Father Ruiz-Sanchez, argues that the planet be given the classification X-1; quarantine from Earth and its people forever. This seems to be for two reasons. First, evolution is so clear on this new planet that he fears that it will undermine belief in creation. Second, their perfect morality in the absence of God and religion is a trap of the 'Ultimate Enemy', the devil, who would tempt people who encountered such aliens into thinking that they can live well without belief in God (Blish, 1958). The novel is quite bizarre in its theology at times, but it does exhibit some of the fears of encountering ETI, compared to Grasso's much more positive assessment above.

Nevertheless, it is difficult to imagine that the mix of good and evil, selfishness and self-giving which universally characterizes human societies is not in some way also present in ETI. In the fantasy stories of Lewis's friend Tolkien, as well as in the Narnia stories, themes of sin and redemption feature strongly (Hillegas, 1969). Might this be fundamental to communities of intelligent life in this creation? Does the very nature of evolutionary development and capacity for self-consciousness present the freedom to reject God and oppress others?

While this may be theologically interesting, it may also have an impact on the kind of protocols for first contact that we discussed in Chapter 6. What moral character might we expect? Will ETI be malevolent or friendly? Peters has characterized two models: the *celestial saviour model* and the *alien enemy model* (Peters, 2011). According to the first model, ETIs have evolved longer and progressed further in science, technology, morality, and medical care. They then bring these benefits to us. Peters rightly sees this as a secular form of salvation, or the 'ETI myth' (Peters and Helrich, 2008: 109–20). The alternative is the belief that ETI will come as conquerors to use the human and physical resources of the planet for their own development. Peters, of course, concludes that it will be more complex. He suggests that it is reasonable for a Christian to surmize the likelihood of ambiguity based upon our terrestrial experience, wherein the human condition replete with sin and suffering is inextricably embedded in our relation to the natural domain from which we have evolved.

Robert Russell suggests the same:

> *I predict that when we finally make contact with life in the universe… it will be a lot like us: seeking the good, beset by failures, and open to the grace of forgiveness and new life that God offers all God's creatures. (Russell, 2000: 66)*

O'Meara tries to explore the complexity even more. He speculates that there may be planets where natural destruction is not needed for evolution. In addition, sin in other races might not weaken the personality extensively, or sin might touch individuals but not collectively (O'Meara, 2012: 25). I think such speculation goes too far. I agree with Peters and Russell that our best guess is that ETIs will resemble the ambiguous human condition—good, fallen. and looking for grace.

So, if that is the case, does each ETI need its own incarnation? Christian Weidemann suggests that based on his 'best guesses' of how many civilizations we might expect to exist in the Universe, and how long planets and civilizations are expected to survive, God's incarnations would have had to be in about 250 places simultaneously at any given time, assuming each incarnation took about thirty years (Allen, 2011). It is fair to say that his best guesses are a little high!

Furthermore, it is fair to say that all best guesses in this area are rather speculative, both in science and theology. For Christian theology there are not enough data with which to work—in particular, biblical data. It is one of these areas where we may have to wait to encounter ETI before we begin to see how to think more about these things.

Yet the Christian theologian does not consider the nature, origin, or consequence of sin in isolation. The story of sin needs to be read in the light of the gospel—especially the work of Jesus on the cross to offer forgiveness and break the power of sin. Here is God the Creator continually reaching out to overcome the separation caused by human sin. As Paul will write later in Colossians, when we were dead in our sins God has made us alive with Christ, forgiving us all our sins and triumphing over evil by the cross (Colossians 2:13–15). As Moltmann says: 'Human sin may certainly pervert human beings' relationship to God, but not God's relationship to human beings' (Moltmann, 1985: 232).

## 10.3 The Cross—Once for All?

The question of whether aliens sin leads to a consideration of God's response to sin. For Christian theology the focus of God's response is the

death of Jesus on the cross. But is that work of redemption once for all, or could it be repeated on different worlds?

There are a number of Christians who will use this argument against any belief in ETI, highlighting, for example, a passage from the Letter to the Hebrews declaring that Jesus, the author of all creation, sacrificed Himself 'once for all' (Hebrews 9:23–28, 10:9–14) (Conner *et al*., 1998). For Protestant Christians this sense of the death of Jesus being a single and universal event has strong historical roots in the Reformation which opposed an understanding of the Eucharist as a repeat of the sacrifice of Jesus (Knox, 1983; Smail, 2005).

Paine presses the same point in even stronger language but with a different motivation. It was little and ridiculous to believe that the Christian story could be normative for the vast Universe:

> *From whence… could arise the… strange conceit that the Almighty… should… come to die in our world because, they say, one man and one woman had eaten an apple! And, on the other hand, are we to suppose that every world in the boundless creation had an Eve, an apple, a serpent, and a redeemer? In this case, the person who is irreverently called the Son of God, and sometimes God himself, would have nothing else to do than to travel from world to world, in an endless succession of death, with scarcely a momentary interval of life. (Paine, 1795: 283)*

E. A. Milne was very open to the possibility of God creating extraterrestrial life, but he combined this belief with resistance to more than one incarnation:

> *God's most notable intervention in the actual historical process, according to the Christian outlook, was the Incarnation. Was this a unique event, or has it been re-enacted on each of a countless number of planets? The Christian would recoil in horror from such a conclusion. We cannot imagine the Son of God suffering vicariously on each of a myriad of planets. The Christian would avoid this conclusion by the definite supposition that our planet is in fact unique. What then of the possible denizens of other planets, if the Incarnation occurred only on our own? We are in deep waters here in a sea of great mysteries. (Milne, 1952: 153)*

Milne eventually solves his great mystery by suggesting the sending of the good news by radio waves! Appealing to the new science of radio astronomy, Milne suggested a possible solution through interstellar radio evangelism by beaming the Christian message into space:

> *In that case there would be no difficulty in the uniqueness of the historical event of the Incarnation. For knowledge of it would be capable of being transmitted by signals to other planets and the re-enactment of the*

> *tragedy of the crucifixion in other planets would be unnecessary. (Milne, 1952: 153)*

While this would be no doubt attractive to some tele-evangelists, it has a major problem. As we made clear in Chapter 3, these missionary messages would take a very long time to reach their audience, never mind the possibility of sending missionaries. This factor should not be underestimated. Would God allow some intelligent life in the Universe to be physically barred from hearing this supreme revelation of himself?

Nevertheless, this is not completely a new problem for the Christian faith. Theologians have long wrestled with the question concerning those who, because of where or when in world history they were born, do not have the opportunity to hear the gospel of Jesus (White, 1991). The question of aliens is simply an extension of this. Some revelation of the character of God can be seen in the creation itself, and it is clear that a person can be saved through Christ without having heard of Christ. For example, Abraham, who lived a long time before Jesus was even born, is classed as someone put right with God (James 2:23–24). He was put right by faith in the grace of God by looking forward to God's particular act, rather than as Christians of today, who are put right by faith by looking back on that act. Aliens beyond the reaches of communication could follow a similar pattern.

Nevertheless, Milne's view was severely criticized by the theologian E. L. Mascall in his Bampton lectures in 1956. He argued that Milne's theology is deficient concerning the work of Christ, in the sense that the 'necessary and sufficient condition for it to be effective' is all should know about it. If salvation was what God was all about, then God would ensure that his creatures could know about it. Mascall stresses that salvation has to be achieved through incarnation. That Jesus became human means that it is doubtful that his saving work would be for different types of being:

> *For the latter, the essence of redemption lies in the fact that the Son of God has hypostatically united to himself the nature of the species that he has come to redeem… It would be difficult to hold that the assumption by the Son of the nature of one rational corporeal species involved the restoration of other rational corporeal species (if any such exist)… Christ, the Son of God made man, is indeed, by the fact that he has been made man, the Saviour of the world, if 'world' is taken to mean the world of man and man's relationships; but does the fact that he has been made man make him the Saviour of the world of non-human corporeal rational beings as well? This seems to me to be doubtful. (Mascall, 1956: 37–9)*

Mascall also suggested that Milne's view of the suffering of the crucifixion was incomplete and therefore misleading. Stressing that the death and resurrection of Jesus are one act, the suffering of the cross is transformed

by the achievement of redemption and the triumph of the resurrection. So, he says that if this suffering is changed into glory, why cannot this happen on multiple planets? This led Mascall to his preferred alternative that the Incarnation is repeated on other planets:

> *The suggestion which I wish to make, with all the tentativeness that is proper to a matter about which we are in almost complete ignorance, is that there are no conclusive theological reasons for rejecting the notion that if there are, in some other part or parts of the universe than our own, rational corporeal beings who have sinned and are in need of redemption, for those beings and for their salvation the Son of God has united (or one day will unite) to his divine Person their nature, as he has united to it ours… [If] the Incarnation takes place not by the conversion of the Godhead into flesh but by the taking up of manhood into God, there seems to be no fundamental reason why, in addition to human nature being hypostatically united to the Person of the divine Word, other finite rational natures should not be united to that Person too. (Mascall, 1956: 39–40)*

As we saw earlier, Paul Tillich believed also that the incarnation might not be limited to one planet:

> *Man cannot claim to occupy the only possible place for Incarnation… The interdependence of everything with everything else in the totality of being includes a participation of nature in history and demands a participation of the Universe in salvation. Therefore, if there are non-human 'worlds' in which existential estrangement is not only real… but in which there is also a type of awareness of this estrangement, such worlds cannot be without the operation of saving power within them. (Tillich, 1953: 2.96)*

Such a view has many advocates. The Christian singer Larry Norman expressed it in his song 'UFO':

> And if there's life on other planets,
> Then I'm sure that he must know.
> And he's been there once already,
> And has died to save their souls.[1]

From a completely different style of music and part of the Church, it is also noteworthy that this view became embedded in a Christmas carol of Sydney Carter:

> Who can tell what other cradle,
> High above the Milky Way,

[1] Larry Norman, 'UFO'. Reproduced by permission of Cyril Shane Music Ltd.

Still may rock the King of Heaven
On another Christmas Day?

Who can count how many crosses
Still to come or long ago
Crucify the King of Heaven?
Holy is the name I know.

Who can tell what other body
He will hallow for his own?
I will praise the Son of Mary,
Brother of my blood and bone.

Every star and every planet,
Every creature high and low,
Come and praise the King of Heaven,
By whatever name you know.[2]

These songs are simply expressing a truth at the heart of Christian faith: God loves, and because of his love, acts. That there is no limit to that truth allows it to be transferred to the speculation of extraterrestrial intelligence.

Milne and Mascall present Christian theology with two models—one of them a model of a God who becomes incarnate as a human being and dies on the cross to offer redemption for the whole Universe. This is *universality from particularity*. It finds resonances throughout the New Testament, not least in the Colossians 1 passage examined above. Here Christ is seen to be the agent not just of creation but also reconciliation. The extent of this reconciliation knows no bounds. Paul uses a parallel in verses 19 and 20. As nothing of the fullness of God was left out of Jesus, so nothing is beyond his reconciling work. So the work of shedding blood on the cross is for all things. The discovery of ETI in this model would mean a development of the theology which already tries to grapple with questions of how salvation comes to those who have never heard of the Jesus event.

C. S. Lewis responds to one of the perceived problems of this model. Like Paine, he says that it is arrogant to believe that God would work on planet Earth when we are such a small part of the whole. He suggests that it would be a mistake to think

> *that the Incarnation implies some particular merit or excellence in humanity… it implies just the reverse: a particular demerit and depravity. No*

[2] Sydney Carter. © 1961 Stainer and Bell Ltd; used with permission.

> *creature that deserved redemption would need to be redeemed. They that are whole need not the physician. Christ died for men precisely because men are not worth dying for; to make them worth it. (Lewis, 2000)*

Putting this in context he writes:

> *It is, of course, the essence of Christianity that God loves man and for his sake became man and died. But that does not prove that man is the sole end of Nature. In the parable, it was the one lost sheep that the shepherd went in search of: it was not the only sheep in the flock, and we are not told that it was the most valuable—save in so far as the most desperately in need has, while the need lasts, a peculiar value in the eyes of Love. (Lewis, 1990: 14)*

The second model is about multiple incarnations and multiple redemptive events. This is *universality by particularity*; that is, God offers salvation by particular acts in lots of different places. It locks together revelation and redemption and makes the assumption that aliens have fallen in the same way as have human beings.

Milne and Mascall also remind us that this question leads us into 'a great sea of mysteries' and a 'matter about which we have complete ignorance'! It is worth sounding that note of caution and acknowledging that it may not be until we actually encounter ETI that we can make further progress. However, SETI does pose questions in this area which build upon questions of Christian theology's important and immediate concern of how to relate to those of other faiths and none. It highlights some key areas which need further theological thinking:

- What is the relation of incarnation to other forms of revelation by God?
- What are the nature, origin, and consequences of sin?
- What is the relation of revelation and redemption?
- What is the extent of the universality of the death and resurrection of Jesus Christ?

Perhaps it is neither the Milne nor Mascall option. Lyons, in commenting on the Church father Origen, points to a different model:

> *Origen presents Christ's redemptive work as a transcendent action which gradually through time takes effect in every realm of creation but which, nevertheless, needs to find corporeal expression in a particular place on a particular occasion (that is, on Calvary). (Lyons, 1982: 214)*

Pannenberg believes that one incarnation is enough for the entire cosmos. As Christ is the one through whom all things were made and all things hold

together, the significance of the historical Jesus on Earth extends to the history and destiny of farthest reaches of the Universe. This allows him to be relaxed about SETI: 'It is hard to see . . . why the discovery of non-terrestrial intelligent beings should be shattering to Christian teaching.' (Pannenberg, 1991–98: 76). This has to be a sound conclusion. Our review of the different options may not clarify which option is correct, but it does show that Christian theology has the resources to not fear the question that SETI poses. John Polkinghorne, one of the contemporary leaders of the science-and-faith dialogue, sums it up well by saying: 'If little green men on Mars need saving, then God will take little green flesh . . . He will do what is necessary' (Polkinghorne, 1996). The Christian conviction is that the God who is encountered in Jesus will do what is necessary.

## 10.4 New Creation

As we saw in Chapter 1, the Heaven's Gate cult believed that at death their spirits would be taken up by an alien spacecraft and transported off to heaven. In fact, this is not too different from the popular interpretation of the Christian gospel in that the hope awaiting believers is of a spiritual heaven, when at death the soul and body become parted. While this is a widely held belief, it is very different from the picture that is consistently painted by the authors of the New Testament. Recently a number of us have argued that the soul ascending to an immaterial heaven owes more to Greek dualism rather than to the message of the Bible, and for the centrality of resurrection and new creation (Wright, 2007; Wilkinson, 2010; Thiselton, 2012).

Christian hope is based on the transformative power of God in the whole person and the whole cosmos. First, the resurrection of Jesus provides the historical evidence and first fruits for God's purposes for the whole of creation. Second, resurrection of the body is the future after death for believers rather than the eternal survival of the soul. Third, new creation rather than heaven is the main picture of hope for the future of life and the Universe. This means that believers are not plucked out of this material existence and sent off to heaven while the physical Universe is thrown away. God's plans are to transform the space, time, and physicality of this Universe into a new creation.

In parallel to the discussion above about the cosmic significance of the cross, this assumes that the resurrection of Jesus has cosmic implications. Just as the passage from Colossians 1, explored above, speaks of the supremacy of Jesus in creation, it parallels creation and new creation to

present Jesus also as supreme in new creation. For example, everything is related to Jesus in creation (v16b) and in new creation (v20c). The agent of creation is also the goal to which the creation tends—its eschatological purpose. One of the key aspects of this new creation is reconciliation. Sin is overcome by Jesus' death on the cross, and Paul's use of 'blood' (v20) provides a model for this reconciliation in the idea of sacrifice. However, his canvas is large. Another parallel between the One who creates 'all things' and reconciles 'all things' emphasizes the universal scope of God's action. In fact, this is further emphasized by yet another parallel between verses 19 and 20. His argument is that because 'the fullness' of God was in Christ then there will be a fullness of 'all things' redeemed. The image of reconciliation also has the sense of bringing the entire Universe into a new order and harmony, a fulfilment of God's plan for it (Wright, 1986).

Therefore, in the many parallels that the writer uses we see again the centrality of Christ, and we have a clear understanding of the link between the resurrection of Jesus and the reconciliation of all things. As Wright puts it, 'with the resurrection itself, a shock wave has gone through the entire cosmos: the new creation has been born, and must now be implemented' (Wright, 2003: 239). But we may ask what it really means for a shock wave to go through the entire cosmos. In what sense is the new creation born? Perhaps the image of birth is not a bad image in this context. The birth of a child is a dramatic event which has both immediate effects and points forward to a new phase of family life. We can see the pointers to the future in the resurrection. But what are the immediate effects of the resurrection on this creation? Interestingly enough, the gospel writers see little immediate effects on creation in the aftermath of the resurrection. Indeed, Matthew's earthquake and associated upheavals happens at the death of Jesus (Matthew 27:51–53). The immediate effects are, of course, on transformed, hopeful, and puzzled people. The birth of the new creation is seen in the power of the gospel to change lives. However, the dramatic and immediate effects should not blind us to the longer-term consequences. In terms of systematic theology, this passage of Colossians always asks us to expand our horizon in these consequences.

In this sense of the cosmic setting of the resurrection we could see how Origen's understanding of the cross could also apply here. In Lyons' words, a 'transcendent action which gradually through time takes effect in every realm of creation but which, nevertheless, needs to find corporeal expression in a particular place on a particular occasion'.

However, there are other aspects of Christian eschatology which raise further questions. The fulfilment of new creation and the ending of this

creation seems focused in the return of Jesus Christ in glory (Matthew 24:26–27; 1 Thessalonians 4:13–18). Some say that this has to happen on the Earth, and therefore because of the importance of this event we are alone in the Universe. Yet 'every eye shall see him' surely says that this event is beyond the normal constraints of space and time. There is no problem with its being seen not just simultaneously on the Earth but also throughout the Universe. This has to be the case. If it were not, the Lord of heaven and Earth would be a rather small deity, and his purposes would not reach the whole of creation.

Finally, Steidl rightly sees the future hope as not souls ascending to heaven but God being encountered intimately within the new creation. Yet he uses this to argue against SETI:

> *He is moving His home to Earth permanently in a wonderful marriage of heaven and earth. What does this mean for our question of life on other planets? It shows that God's ultimate eschatological plan is Earth-centred. In the end, God, the Lord of the Universe lives on Earth. Does this mean that intelligent races on other planets will come up to planet Earth to worship God just as the Gentiles came up to Jerusalem to worship Israel's God? Again, the simpler solution is to reject the notion that there is life on other planets. (Steidl, 1979: 230–2)*

It is interesting yet again that a doctrine about God's initiative in reaching out to human beings means that God's plan is 'Earth-centred'. Throughout the last two chapters I have argued that God's acts in both creation and redemption do show a special concern and love towards human beings, but that does not mean that God is Earth-centred. SETI is a reminder about how easy it is to fall into J. B. Phillips' famous concern that 'Your God is too small' (Phillips, 1997).

# 11
# Be Not so Positive

At any day in the future the world could be transformed. The evidence of complex life on a moon within the Solar System or an exoplanet would encourage even more the belief that there must be other more developed life in the Universe. A signal from a distant civilization, once verified and interpreted, would be greeted by worldwide excitement and apprehension. One cannot imagine the news coverage if then little green men and little green women did arrive and say 'Take me to your leader'! Such possibilities are of low probability but very high impact. Indeed, alternatively, we may go on forever living with the eerie silence of the galaxies.

Responding to such possibilities can lead to a number of different reactions. The pioneer of SETI, Frank Drake, once commented on the discovery of a signal from an extraterrestrial civilization: 'This discovery, which I fully expect to witness before the year 2000, will profoundly change the world' (Drake and Sobel, 1994). In contrast, the founder of Methodism, John Wesley (1704–1791) was a little more reticent. He had some reservations about the existence of extraterrestrial life. Becoming involved in 1765 in the debate, he urged his adversaries to 'Be not so positive' (Wesley, 1978: 13.399).

As a good Wesleyan, on this occasion I am very happy to follow John Wesley's advice. The topic of SETI is scientifically and theologically complex, and much as I would like to be able to make firm predictions, we still do not have enough data which gives sufficient confidence to be so positive.

Yet this is a fruitful and exciting field for both science and theology. It connects with a public fascination which works its way out in many different ways from science fiction movies, through popular science, to new religious movements. It has been a constant theme in the history of the relationships of science and religion, encouraging both scientific observation and theological speculation. The science of SETI links physics,

biology, psychology, and sociology, and feeds into questions of planetary formation, the origin of life, the development of intelligence, interstellar communication and travel, and what it means to be human. It is a field which drags theologians outside their comfort zones and beyond the inevitable anthropocentricity of much thinking.

At the time of writing, current scientific insights lead me to the tentative conclusion that we are alone as intelligent life in this Milky Way galaxy. Although the recent discoveries of planets beyond the Solar System are changing the grounds of discussion almost daily, the Fermi paradox remains a very strong argument against other civilizations. However, I do believe that we will find evidence of life on other worlds. The only trouble is that I think this will be primitive life.

That leaves open the possibility of intelligent life in other galaxies so far from us that the Fermi paradox does not rule it out. 'Where is everybody?' is answered by 'They are there but too far away'. The real difficulty with this option is a question of epistemology; that is, will we ever obtain evidence that they are there.

However, I want to remain open to the possibility of finding evidence for ETI. Indeed, I want to be more proactive and to support SETI as a worthwhile scientific research programme. In part I am motivated towards this by science. The scientific evidence remains a tip of the iceberg, and the scientific arguments are not conclusive one way or the other. However, part of the motivation is my Christian faith. I believe fundamentally that the nature of the Universe is explored only through observation. The Creator God is an extravagant creator who gives us the gift of science to discover more about that extravagance. In addition, I would not be surprised that the God who creates a Universe where the laws of physics and biology lead to such extravagance in the natural world of the Earth takes delight in other life elsewhere in the Universe.

What we can be positive about is the fruitfulness of the relationship of science, religion, and SETI.

## 11.1 The Religious Motivation of SETI

For Frank Drake, SETI had to be motivated in the face of religious belief:

> *Indeed, if there is anything unusual about my otherwise normal childhood, it is that I started tracing my ties to alien civilizations of intelligent life in the universe at age eight. I did this in spite of my family's fundamentalist religious beliefs and despite their scorn for fantastic ideas. (Drake and Sobel, 1994: 2)*

Yet motivation can happen in lots of ways. A worldview can motivate action, or action can be motivated by wanting to find an alternative worldview. The motivation for SETI has a number of different contrasting elements. There are those who believe in SETI because of their faith position, those who want to find in SETI a substitute for terrestrial religions, and those who find intriguing religious questions in SETI.

By surveying the writings of scientists and those who are part of the subculture of science fiction, alien contact, and 'ufology', a number of similar themes begin to emerge. These resonate with themes which have been at the heart of religious belief (Wilkinson, 1997). First is a theme which can be described only as *cosmic loneliness.* David Hughes writes:

> *The confirmation of the existence of extraterrestrial life is billed as the greatest possible scientific discovery of all time. Today, however, we are still experiencing the pangs of cosmic loneliness. Never mind not coming to visit, no extraterrestrial being has even left a calling card or shouted at us from a distance. What is even more enigmatic is the realization that it is just as amazingly incredible to insist that Earth is the only repository for sentient life-forms in the Universe as it is to envisage the hoards of other inhabited planets orbiting billions of distant stars. (Hughes, 1996: 183)*

Greta Garbo once famously proclaimed 'I want to be left alone', and it remains a chilling thought for the rest of us that we as a species might be alone in the immensity of the Universe. The conflating of the question of whether there is other life in the Universe to whether there is other intelligent life in the Universe is given energy by this theme. A Universe full of bacteria would not combat this sense of cosmic loneliness. The great attraction of science fiction, whether in *ET* or in *Men in Black*, is to find aliens who communicate and are witty, cooperative, and most of all, friendly. This sense of not being isolated in the Universe has been a core theme in religious belief. In Christianity, God is seen as father, Jesus as friend, and the Holy Spirit as helper. Indeed, without a restored relationship with God, then Christians believe that there is cosmic loneliness. The early Church theologian Augustine put it this way: 'God made us for himself and our hearts are restless until they find rest in Him.'

Second is the theme of *cosmic purpose*. We want to find out about the purpose of the Universe. Are we so unique that the purpose of the Universe is in some way closely linked to us? Or could aliens share some secret knowledge with us? In a widely quoted passage, Nobel Prize-winner Steven Weinberg joins with the cosmic pessimism of Monod, and laments:

> *The more the universe seems comprehensible, the more it also seems pointless. But if there is no solace in the fruits of research, there is at least some consolation in the research itself… The effort to understand the Universe is one of the very few things that lifts human life above the level of farce, and gives it some of the grace of tragedy. (Weinberg, 1977: 154)*

In a later book he comments on this: 'I did not mean that science teaches us that the Universe is pointless, but only that the Universe itself suggests no point' (Weinberg, 1992: 255). This is heightened by the observations that confirm that the Universe is accelerating in its expansion with an end in the futility of heat death (Perlmutter and Schmidt, 2004; Kirshner, 2004; Blake *et. al*., 2008).

Paul Davies argues that this pessimism is a result of the belief that the processes of nature are essentially random. He suggests that an 'almost empty Universe growing steadily more cold and dark for all eternity is profoundly depressing' (Davies, 2002).

Does human life count for nothing? Is there really no purpose to our place in this vast Universe? This is once again a chilling thought. There are those who suggest that we do not ask the question of purpose, but the reality is that most of us do. The belief in extraterrestrial life is a way of getting beyond that:

> *For those who hope for a deeper purpose beneath physical existence, the presence of extraterrestrial life-forms would provide a spectacular boost, implying that we live in a universe that is in some sense getting better and better rather than worse and worse. (Davies, 1995: 52)*

Pessimism is replaced with optimism, though it is hard to see immediately why. Other life in the Universe may give a sense of purpose in terms of Davies' biofriendly Universe, but it is still a very impersonal thing.

Nevertheless, it may give some a sense of purpose. In 1975, John Allan commented: 'There is growing public hunger for something to believe in—something which combines the certainties of science with a religious optimism about the future that science on its own cannot justify' (Allan, 1975: 39). Belief in extraterrestrial life can do that.

Third is the theme of *cosmic identity.* As we have seen from the earliest times, the psalmist was asking the question 'What are human beings?' in the light of the vastness of the Universe.

After the NASA claim of life on Mars on the basis of ALH84001, the science fiction author Ray Bradbury wrote:

> *This latest fragment of data… is only worth our hyperventilation if we allow it to lead us to the larger metaphor: Mankind sliding across the blind retina of the Cosmos, hoping to be seen, hoping to be counted, hoping to be worth the counting. (Bradbury, 1996)*

SETI is part of the quest to find out about ourselves. Ridley Scott's movie *Prometheus* (2012) tells the story of a space voyage seeking the origins of humanity, following a star map discovered among the remnants of several ancient Earth cultures. The crew arrive on a distant world and discover an advanced civilization and a threat that could cause the extinction of the human race. Writer Damon Lindelof said of the movie:

> *We are exploring the future… away from Earth and [asking] what are people like now?… Space exploration in the future is going to evolve into this idea that it is not just about going out there and finding planets to build colonies. It also has this inherent idea that the further we go out, the more we learn about ourselves. (Child, 2011)*

Our identity as human beings is established in relationship, either by differentiation or by commonality. We want to find out about ETI because we want to find out about ourselves. Aristotle said 'All men by nature desire knowledge', but we often want knowledge in relation to our own place in the Universe. How did we get here? Are we unique? Would alien life continue the process of dethroning the centrality of humanity, begun with Copernicus taking the Earth from the centre of the Universe?

Fourth, there is the sense of vulnerability in the face of the Universe, or *cosmic fear*. H. G. Wells' novel *The War of the Worlds* (1898) was a story with a specific purpose. It was written in response to the outrage he felt at the colonialist eradication of the people of Tasmania. His aim was to show what it was like to be a victim of a policy of extermination. However, in 1938 Orson Welles' radio version had a quite different effect on the American public. It produced widespread fear and panic among many Americans who were in the grip of pre-war paranoia. Science fiction works on such fear and paranoia.

This may, of course, be less of a motivation for SETI. It is not as if we want to chart any threats around us in the Galaxy. However, any contact or message from ETI will inevitably raise fear and apprehension. Perhaps that is due to the way that we project our own self-knowledge of human selfishness and aggression onto other civilizations. Or perhaps there is a deeper fear of the fragile nature of human beings and the Earth's biosphere. The planet is vulnerable to asteroidal or cometary impact, and vulnerable to

human over-exploitation and technological disaster. Does SETI touch all these fears?

Vulnerability to the changes in the natural world is linked to the practices and beliefs of early religious movements. In the Judaeo-Christian tradition the image of God as help, deliverer, rock, fortress, and strength is deployed as a comfort to those who are facing fear.

Fifth is the desire for *cosmic salvation.* As far back as 1949, Sir Fred Hoyle pointed out that the motivation for believing in extraterrestrial intelligence was 'the expectation that we are going to be saved from ourselves by some miraculous interstellar intervention' (Hoyle, 1949). The hope for many is that something outside ourselves would come and save us from the reality of the life that we know. We look beyond our present knowledge for hope.

Paul Davies echoes this, seeing that the interest in extraterrestrial intelligence:

> *stems in part…from the need to find a wider context for our lives than this Earthly existence provides. In an era when conventional religion is in sharp decline, the belief in super-advanced aliens out there somewhere in the universe can provide some measure of comfort and inspiration for people whose lives may otherwise appear to be boring and futile. (Davies, 1995: 89)*

SETI enthusiasts have a strong faith in a higher intelligence which is seeking to communicate with us and which can change our lives and solve our problems. Thus Drake, in his book chronicling his own involvement in SETI, comments:

> *Now, after all our efforts over the past three decades, I am standing with my colleagues at last on the brink of discovery…the imminent detection of signals from an extraterrestrial civilization…The point of this book, as of my life's work, is that interstellar contact will enrich our lives immeasurably. (Drake and Sobel, 1994: xii–xiii)*

The SETI hope is that contact with alien civilizations will provide not just scientific insights but also religious and moral insights. Drake goes from technological advance to immortality:

> *I fully expect an alien civilization to bequeath to us vast libraries of useful information, to do with as we wish. This 'Encyclopedia Galactica' will create the potential for improvements in our lives that we cannot predict. During the Renaissance, rediscovered ancient texts and new knowledge flooded mediaeval Europe with the light of thought, wonder, creativity,*

> *experimentation, and exploration of the natural world. Another, even more stirring Renaissance will be fuelled by the wealth of alien scientific, technical, and sociological information that awaits us… I suspect that immortality may be quite common among extraterrestrials. By immortality I mean the indefinite preservation, in a living being, of a growing and continuous set of memories of individual experience . . Sometimes, when I look at the stars I wonder if, among the most common interstellar missives coming from them, it is the grand instruction book that tells creatures how to live forever. (Drake and Sobel, 1994: 160–2)*

Steiner has pointed out that the most creative people in art and poetry make a wager on the world and history having meaning and hope (Steiner, 1989). He calls it a wager on the meaningfulness of meaning. The Christian tradition makes a similar wager, but this wager is on the God of the resurrection. The resurrection both disrupts this world's belief that death is the end and there is no hope, and offers the evidence that God will make things good in the end. Confidence is not placed in human beings or technology or ETI, but on God. Furthermore, the resurrection reminds us that there is more to hope than just survival.

## 11.2 The Value of SETI to Christian Theology

Throughout this work we have consistently argued that it is far too simplistic to place SETI in conflict with Christian belief. C. S. Lewis, with characteristic wit, made a similar point in commenting on atheists' attempts to use both sides of the ETI debate to attack Christian faith:

> *If we discover other bodies, they must be habitable or uninhabitable: and the odd thing is that both these hypotheses are used as grounds for rejecting Christianity. If the Universe is teeming with life, this, we are told, reduces to absurdity the Christian claim—or what is thought to be the Christian claim—that man is unique, and the Christian doctrine that to this one planet God came down and was incarnate for us men and our salvation. If, on the other hand, the Earth is really unique, then that proves that life is only an accidental by-product in the universe, and so again disproves our religion. Really, we are hard to please. (Lewis, 1990: 14)*

Moving beyond the conflict model which seems to dominate so much of the relationship between science and religion, we find a much more complex, challenging, affirming, and indeed liberating dialogue. One of the great contributions to Christian theology of the natural sciences has been the expanding of perspective. The natural sciences have led to a better interpretation of the

Scriptures, not least in the early chapters of Genesis (Wilkinson and Frost, 2000; Barton and Wilkinson, 2009). Quantum theory and Relativity have challenged the 'tyranny of common sense' which led to the acceptance by theologians of the sterile predictable mechanistic Universe (Polkinghorne, 2007).

SETI, either in its current speculation of what may happen in the future, or indeed if it is successful, challenges the anthropocentricity which is so characteristic of much Western Christian theology. Polkinghorne has argued that the context of science is very important for theology, and likens it to movements such as feminist and liberation theology (Polkinghorne, 2008). These movements showed how dominated theology was by structures of gender and power.

SETI in particular can help theology to be liberated from seeing human beings and the Earth as the sole focus of God's love and work. This is a further step beyond those who in the past have focused God's attention on one nation, on men, on the rich and powerful, or on the religious. Feminist and liberation theologies have been criticized, in the passion of justice for women and the poor, of giving the impression that men and those who are rich in the world are not part of God's special interest. In addition, some forms of feminist and liberation theology have diluted orthodox Christian belief.

We have therefore been careful in keeping Jesus Christ central to the discussion of the implications of SETI for Christian theology. By doing so, I suggest we can be open to the insights of SETI while still seeing God's special care for human beings and his particular acts on the Earth. I am convinced that in the openness that the Christian theologian must show to observations of the world, new insights into the richness of God's work in Jesus Christ will be discovered. Christians should not be afraid of the religion of alien beings, just as they should not be afraid of human beings from the different faith communities in the world. The belief that God has revealed himself in a supreme way frees one to look for that which is of God outside that particular revelation. Christians should expect to learn new things about God from an encounter with aliens, but they would also be in a position to share the good news that God has revealed himself in becoming a human being and offered salvation.

Wiker warns of the danger of hitching theological doctrines to the science of the day, and commends the history of science for showing us that 'today's verities are often tomorrow's absurdities' (Wiker, 2002). There is, of course, much wisdom in this, as the early chapters of this book show. In extreme form, the origin of cults is to take contemporary science and indeed pseudoscience and mould religious philosophy around them. Yet the history

of the interaction of speculation about a plurality of worlds and theology has produced a long tradition of re-examination and renewal of doctrines such as the freedom of God in creation.

Mary Doria Russell's book *The Sparrow* is another science fiction story of a mission to explore and make contact with an intelligent world. This time, in response to a signal picked up from another star, and while the UN debates the issues around first contact mission, the Jesuits organize a mission of their own. In the prologue she writes:

> *The Jesuit scientists went to learn, not to proselytize. They went so that they might come to know and love God's other children. They went for the reason Jesuits have always gone to the farthest frontiers of human exploration. They went* ad majorem Dei gloriam*: for the greater glory of God. (Russell, 1996: 3)*

As one might expect, the ideal does not live up to the reality, but SETI is of value to Christian theology because it has the possibility of showing more of the greater glory of God.

The writer of Psalm 19 speaks of the heavens declaring the glory of God (Psalm 19:1). There are some difficult questions for the Christian faith, but no questions that have not already been grappled with, and no questions that prove destructive. Commentators from within and outside the Church are wrong to see SETI as a major problem for the truth of biblical Christianity.

In a letter written in 1647, Descartes, discussing the saving work of Jesus on the cross, commented:

> *I do not see at all that the mystery of the Incarnation, and all the other advantages that God has brought forth for man obstruct him from having brought forth an infinity of other very great advantages for an infinity of other creatures. And although I do not at all infer from this that there would be intelligent creatures in the stars or elsewhere, I also do not see that there would be any reason by which to prove that there were not. (Descartes, 1897: 3.54–5)*

SETI may teach Christian theologians humility; or to put it another way, Christian theologians need to come to SETI with humility.

## 11.3 The Value of Christian Theology to SETI

In speculating on first contact with an alien civilisation, the Roman Catholic theologian Stanley Jaki suggested that it is only the theist who can look

forward with confidence to such an encounter, trusting that both sides will have a common Creator and a sense of brotherhood (and sisterhood) (Jaki, 1980). At the other end of the spectrum of views there will inevitably be those who will say that religion should keep well away from such matters, as it has only a negative effect on human progress. While to my knowledge Richard Dawkins has not spoken directly on this matter, his general view of the value of theology would not encourage optimism:

> *What has 'theology' ever said that is of the smallest use to anybody? When has 'theology' ever said anything that is demonstrably true and is not obvious? (Dawkins, 1993)*

By contrast, there does seem to be a genuine openness within the SETI scientific community to the contribution of the arts and humanities, including theology. Douglas Vakoch of the SETI Institute suggests four areas in which theology can make a contribution to SETI (Vakoch, 2011a; Vakoch and Harrison, 2011; Vakoch, 2011b). First, theology may help us in thinking about the nature of extraterrestrial life or indeed our own assumptions about the nature of ETI. Central to the theological task has been a long engagement with the question of what makes us human, and the complex nature of good and evil within human personalities and communal structures. Second, theological perspectives may help anticipate the consequences of future contact. He suggests that religious and non-religious people may react differently and therefore affect public policy if a signal is received. Faith communities continue to be a significant dimension, and indeed in some parts of the world show considerable growth. Third, theology can expand our spiritual perspective to think about how other life-forms would relate to God. Fourth, such theological thinking would help us deal with new forms of Earth-based intelligence, whether this is natural or artificial. This is a really helpful invitation to religious thinkers to participate in discussion about the research and preparations for possible contact.

As a Christian theologian I would like to add four more areas where theology can make a contribution. First, *theology should encourage and affirm the scientific discipline of SETI*. In a world where SETI continues to be vulnerable to cuts in funding, the theologian will want to stress the importance of SETI both in its commitment to find out more about the Universe through observation and also in its central question of whether we are alone in the Universe. As Kepler said: 'Science is thinking God's thoughts after him.' For many of us the success of SETI would pose some interesting questions, but, far from destroy faith, it would enrich a sense of the greatness and extravagance of God.

Second, *theology can assist in examining some of the assumptions upon which SETI is built*. We have seen through history and into the present the key assumptions of the uniformity of nature, the principle of plenitude, and the Copernican principle. Theology gives philosophical grounds for believing that the laws of nature are the same throughout the Universe. However, it is cautious about that whatever is possible tends to become realized. The doctrine of creation stresses the freedom of the Creator, and also that this creation is not destined simply to go on forever. In addition, theology would want to stress the value of all life as God's creation rather than to just believe that intelligent life is important. Theology also encourages the Copernican principle as opposed to the Aristotelian Universe, but at the same time rejoices in the nature of humanity in terms of God's gift of intimate relationship.

Third, *theology will want to stress the importance of an ethical dimension in any contact with life-forms elsewhere in the Universe*. While Christianity shares in the legacy of the misuse of the Earth's environment, it now seems to have learned its lessons. Indeed, there is a very important religious dimension to environmental care, for cultural change cannot be achieved by scientific arguments alone. The World Wide Fund for Nature implicitly acknowledged this when it held its 25th anniversary celebration in 1986 at Assisi, and called on the world's great religions to proclaim their attitudes towards nature. They recognized that the scientific has to go with the theological, with the result that there is a deeper spiritual and practical understanding of nature and the environment than ever before (Palmer *et al*., 1987). Decisions about contact with ETI, and perhaps more likely the conservation of a diversity of simpler life-forms, will be part of this discussion. In addition, the engineering of planetary atmospheres for human habitation is already being discussed (Zubrin and Wagner, 1997; McKay, 2000). Rees sees the importance of this 'terraforming' as giving the human race a safeguard against possible disasters affecting the Earth (Rees, 2003a). But how should this be done in a way that stops other planets and other life-forms simply being exploited for human gain? Christian theology's emphasis on the whole Universe as creation, and God's purposes of transforming the whole creation to new creation, has a contribution here.

Fourth and finally, *theology can make a contribution to a wider perspective on SETI*. In Washington National Cathedral the stained glass 'Space Window' features a Moon rock returned to Earth by the crew of Apollo 11. The 3.6-billion-year-old rock is encased in an air-tight, nitrogen-filled capsule in the window, which features stars and orbiting planets. Armstrong, Aldrin, and Collins delivered the 7-gramme sample from the

lunar Sea of Tranquillity during a ceremony at the Cathedral on 21 July 1974, five years after their Moon-landing. Armstrong said:

> *On behalf of the President and the people of the United States we present unto you this fragment of creation from beyond the Earth to be imbedded in the fabric of this house of prayer for all people. (Armstrong, 2012)*

Here, the exploration of space is honoured in a place of Christian worship.

When Armstrong and Aldrin were on the Moon, there was another symbolic representation of the intertwining of science and religion. Aldrin details it in his book *Magnificent Desolation* (Aldrin and Abraham, 2010). Before he and Armstrong stepped out of the lunar module, Aldrin sent a message back to the Earth:

> *I would like to request a few moments of silence… and to invite each person listening in, wherever and whomever they may be, to pause for a moment and contemplate the events of the past few hours, and to give thanks in his or her own way.*

He then took some bread and wine which had been given to him by his church—Webster Presbyterian church near Houston, where he was an elder. Reading from John's gospel, he then took these communion elements.

It is sometimes said that this was hushed up because NASA was struggling with lawsuits from atheist Madalyn Murray O'Hair, following the reading of the Genesis account of creation by the Apollo 8 crew. She wanted religion separated from NASA's activities and to keep it out of space. Certainly Aldrin did not broadcast his personal act of worship, even though it was reported at the time (Associated Press, 1969).

Every July, Webster Presbyterian church holds a 'Lunar Communion Sunday', where the tape of Aldrin on the Moon is played and Psalm 8 recited. Judy Allton, a historian of Webster Presbyterian church, suggested that communion could be an essential part of future space travel, and claimed such rituals 'reinforce the homelink' (Cresswell, 2012).

Whatever Aldrin's own theological understanding and motivation, the Christian theologian will see such a symbol as rich in meaning. The breaking of bread and sharing of wine means many things within the Christian tradition. It is an affirmation of God's gift of the physical world. It is an encounter with the risen Lord Jesus in the presence of his new community, the Church. It is a retelling of his death and resurrection and the offer of new life to all. And it is a foretaste of the new creation.

For Christians it is an ideal foundational picture for SETI. The affirmation of the physical Universe is a reminder of the importance of science. It is a reminder of humanity's embeddedness in the story of what God has done in Jesus Christ, giving confidence that whatever the Universe turns out to be, human beings are loved. It is an invitation to others to learn from such a story and take part in it. And it points to God's purposes being beyond just this Universe. These things do not provide easy answers to the questions that SETI raises, but they do present a wider perspective. From this perspective, Christians have nothing to fear and a lot to welcome.

The Curiosity rover on Mars was not only tasked with scientific exploration, but also played will.i.am's song 'Reach for the Stars', about the singer's passion for science, technology, and space exploration! Christian theology affirms such curiosity, but wants to offer the contribution that there is more to the Universe than just the stars and SETI.

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# Index of Biblical Passages


Genesis 1 119, 131–3, 135–7, 141–2, 144
Genesis 1–3 131
Genesis 1:1 132
Genesis 1:3 119
Genesis 1:16 135
Genesis 1:21 132
Genesis 1: 24–31 142
Genesis 1:26–28 143
Genesis 1:27 132
Genesis 2 161
Genesis 2:7 142
Genesis 2:19 142
Genesis 3 161
Genesis 9:8–17 131
Genesis 22:17 138

Job 6:18 135
Job 38:1–42:17 131
Job 38:4 132

Psalm 8 131, 140, 142, 183
Psalm 19 131, 180
Psalm 19:1 135, 180
Psalm 19:8 135
Psalm 119: 90 20
Psalm 148 131, 136

Proverbs 8:22–31 134
Proverbs 8:22–36 131

Isaiah 6 120
Isaiah 40:9–31 131
Isaiah 40:18 132
Isaiah 65:17–25 137

Ezekiel 1:1 120
Ezekiel 1:15–21 121
Ezekiel 1:18 121
Ezekiel 1:25–28 121
Ezekiel 1:26 120
Ezekiel 37 120

Daniel 10 120

Matthew 8:27 155
Matthew 24:26–27 171
Matthew 27:51–53 170

John 1:1–3 119
John 1:1–18 158
John 1:14, 18 119

Acts 1:11 22
Acts 17:26 152

Romans 5:12 160
Romans 8:19–22 161

Colossians 1:15–20 145, 153, 158
Colossians 2: 9 154
Colossians 2:13–15 163

1 Thessalonians 4:13–18 171

Hebrews 1:1–4 158
Hebrews 9:23–28, 10:9–14 164
James 2:23–24 165